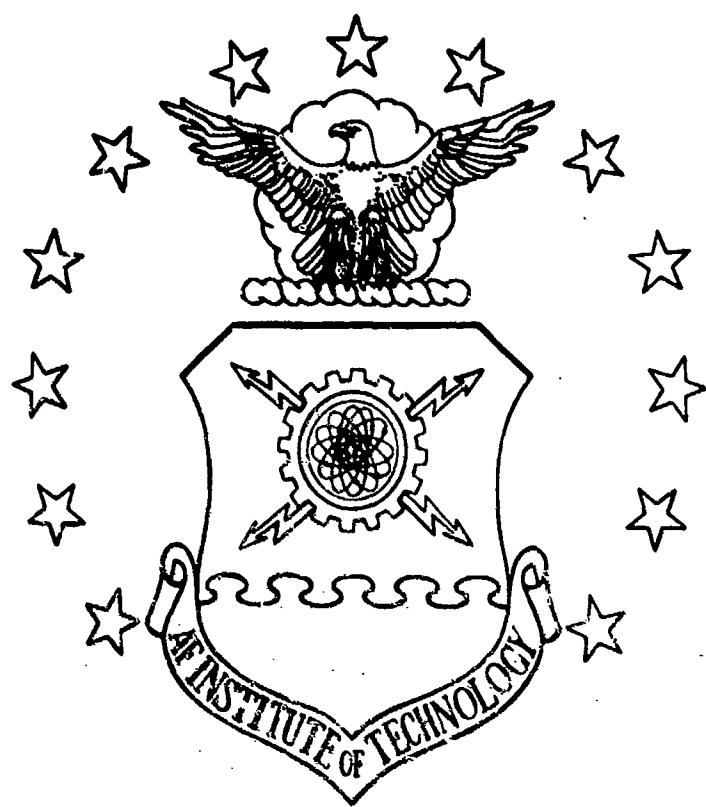


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A BIRD STRIKE HANDBOOK
FOR BASE-LEVEL MANAGERS
THESIS

**Raymond P. Payson
Major, USAF**

James D. Vance
Captain, USAF

AFIT/GLM/LSM/84S-52

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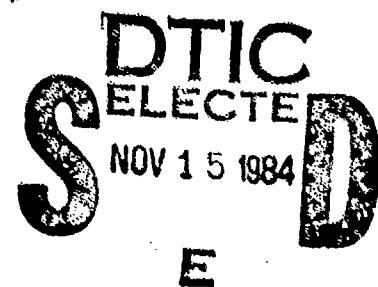
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A BIRD STRIKE HANDBOOK
FOR BASE-LEVEL MANAGERS

THESIS

Presented to the Faculty of the School of Systems and Logistics
of the Air Force Institute of Technology
Air University
In Partial Fulfillment of the
Requirements for the Degree of
Master of Science in Logistics Management

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September 1984

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Preface

Bird strikes have occurred since the beginnings of aviation. The first pilot fatality caused by a bird strike happened when a Wright Flyer struck a gull in 1912. Many years have passed since that first accident, and very little concern developed over the years in preventing bird strikes until the advent of the jet engine. Because the Air Force has placed more recently much emphasis on low-level flying, in particular high-speed missions, the overall numbers of bird strikes have increased. Aircraft and personnel resources are now too valuable and scarce not to be given every safety consideration. The potential hazards associated with bird strikes must be examined more closely as the numbers of bird strikes increase and the resources become more valuable.

In an attempt to compile all relevant bird strike information, we relied almost entirely on published articles, reports, and other significant documents. Because of time constraints we did not approach individuals at the various bases who had experienced bird strikes nor did we interview safety officers at these bases who would have gathered much information on this matter. Our research in that sense is incomplete. On the other hand, it is hoped that the final product will be helpful in generating more interest about the bird strike problem. It is further hoped that the organization of the handbook itself will assist base-level managers in understanding better and preparing for potential bird strike hazards.

A few words about the citations and the bibliographies are necessary. In Chapters 1, 2, 3, and 5, citations are numbered. In Chapter 4,

the handbook portion of the thesis, references are by name, date, and page number. Bibliographies are located after Chapters 3 and 5, and in Chapter 4 after parts 1, 2, 3, 4, 6, and 7. This arrangement will hopefully more readily provide additional information to the interested user.

In writing this thesis, we would like to thank several people whose assistance and patience have helped us immeasurably. Major Geral L. Long and Captain Robert C. Kull, members of the Bird/Aircraft Strike Hazard (BASH) Team, both on numerous occasions quickly provided us with much needed information and data. Mr. Michael J. Harrison of the Federal Aviation Administration, Washington, D.C., offered us a different perspective, seen from the commercial side of aviation. Mr. Ralph Speelman of the United States Air Force Wright Aeronautical Labs gave us yet another very important perspective. Lastly, we would like to thank Dr. Terrance M. Skelton, our faculty advisor, who tactfully guided us in piecing our handbook together. A special thanks goes to Charlene and Bob Vance for their loving support, and to all the women who refrained from keeping the Major away from his thesis work.

Raymond P. Payson

James D. Vance

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Abstract

In recent years, much Air Force aircraft damage (about five million dollars per year) has resulted from bird strikes. Moreover, from 1968 to 1984, 13 military pilots were killed and 16 aircraft destroyed as a result of bird strikes. Instances of strikes are increasing, partly because better records are being kept and partly because aircraft are spending more time at the lower altitudes where strikes occur. As aircraft become more sophisticated and valuable, it is imperative that bird strikes be minimized to prevent aircraft damage or pilot injury.

To help develop more awareness about bird strikes and bird strike reduction techniques, this investigation compiled all relevant information through an extensive literature search, review of base-level documents, and personal interviews. The final product--A Bird Strike Handbook For Base-Level Managers--provides information on bird strike statistics, methods to reduce the strike hazards, and means to obtain additional assistance. The handbook is organized for use by six major base agencies: Maintenance, Civil Engineering, Operations, Air Field Management, Safety, and Air Traffic Control. An appendix follows at the end.

Because aircraft missions change from time to time, the nature of the bird strike problem also changes. More importantly, a bird problem can occur almost anywhere at any time. No base is free from the problem entirely. Through sound understanding of the hazards involved, through proper advanced preparation, and through daily monitoring of the bird threat, then and only then can the probability of a bird strike be minimized.

A BIRD STRIKE HANDBOOK FOR BASE-LEVEL MANAGERS

I. Introduction

The term bird strike refers to the collision between birds and aircraft. This strike may occur during the flight of the aircraft (when airborne) or when the aircraft is on either its takeoff or landing roll. This phenomenon is of critical importance to both civilian/commercial aviation and military aviation, for the damage to and loss of aircraft totals millions of dollars yearly in the United States alone. Unfortunately, the loss of life associated with bird strikes continues.

The bird strike problem is not confined to the United States. Obviously, a bird strike may occur anywhere that birds can be found. Canada and many of the European nations have been conducting research and employing bird strike reduction programs as well, because they too realize the potential for disaster posed by birds. As aircraft continue to carry more people and equipment, the potential losses are greater. More aircraft in the sky greatly increases the chances of having a collision. With the speed of aircraft increasing, the impact force of a bird strike becomes greater and potentially more dangerous.

A variety of methods already exist for dealing with the problem, and many more are being developed. Our emphasis will be to combine these different methods by means of a handbook containing the most current information on bird strike prevention.

Justification and General Issue

As previously mentioned, bird strikes can affect military and civilian aircraft alike. The collision can result in aircraft damage or loss, and injury or loss of human lives. From 1968 - 1984, thirteen military pilots were killed and sixteen aircraft destroyed as a result of bird strikes (4:10). The total for just 1982 came to \$14 million which included the loss of an F-16 aircraft (6). A recent Air Force study also showed that approximately one out of six bird strikes is reported (7:17). In 1982 alone, 2300 birdstrikes were reported in the U.S. Air Force. Therefore, as many as 13,600 bird strikes could have occurred in 1982.

These statistics vividly demonstrate the potential for disaster associated with bird strikes and the need to make accessible the vast amount of research conducted on bird strikes and bird strike prevention, so that effective bird strike prevention can be practiced in the USAF.

Specific Problem

Despite a variety of methods for dealing with bird strike prevention and reduction, bird strikes continue to

be a hazard. These methods range from a bird avoidance model that predicts the likelihood of a bird strike (during a given flight-path, time and date), to efforts aimed at reducing the nesting and feeding of birds near airports. Even methods designed to help aircrews prevent, prepare for, and respond to bird strikes helps to deal with the problem. Yet, despite these measures, the number of bird strikes continues to rise. One reason stems from the lack of education about bird strikes. Aircrew members, maintenance crews, civil engineers, base operations personnel, and airfield managers can all help to reduce the problem if they know the nature of the problem, the scope of the problem, and methods to alleviate the problem.

Lack of education partly results from a lack of information about bird strikes. This is not to say that the information does not exist; rather, it means that the information appropriate for understanding and use by these different individuals is not available. Base level managers do not have any specific reference that accurately identifies bird strikes. They do not know what studies have been done or what methods have been developed, with respect to their field of expertise, that can be used to alleviate the problem. Further, base level managers lack a handbook that relates to their AFSC and provides methods for their use.

Scope and Research Objectives

The goal of this research is to study and compile all relevant information, practices, and procedures that can be used by all bases. Emphasis will be placed in two areas. First, we will provide information for the top managers in the organizations, such as the Deputy Commander for Maintenance (DCM) or the Chief of Airfield Management, and discuss the scope of the birdstrike problem as it relates to his/her responsibilities. Next, we will provide operation plans and checklists for use by individuals within these organizations. The specific organizations we will address are:

1. Maintenance
2. Civil Engineering
3. Operations
4. Airfield Management
5. Safety
6. Air Traffic Control

Some of the information presented is somewhat general so that it can be used by any base.

Therefore, a wide range of information is covered so that the applicable data for all of these areas can be found and condensed. Many studies have been concerned not only with the birdstrike hazard but the problem with pest birds in general. They go into ways to keep birds out of buildings and hangars, so that the droppings will not harm

equipment (via corrosion) or be a health hazard. Our research, however, is limited to the bird/aircraft strike hazard (BASH) and what can be done to reduce it.

The Bird/Aircraft Strike Hazard (BASH) team at Tyndall AFB, Florida, is one source of information for both personal interviews and published reports. Much of the data for this research was compiled from the detailed studies maintained there. The Federal Aviation Administration (FAA) has also condensed a vast amount of knowledge about bird strikes. Likewise, the Air Force Safety Office at Norton AFB, CA., has consolidated information such as statistics on the frequency of bird strikes and locations of bird strikes. The Air Force Engineering and Services Center also at Tyndall AFB gathers information by civil engineers regarding control of birds at different airfields. Information on aircraft structural strengthening, to reduce the effect of a bird/aircraft collision, was obtained from the Flight Dynamics Laboratory at Wright-Patterson AFB, OH. Civilian studies such as the McDonnell Douglas report on bird strikes are useful. Also, various periodicals, such as flying safety magazines and Audubon magazine, are further sources of relevant information.

Consequently, the scope of the problem has been narrowed to what base-level managers can do by themselves (and collectively) for the reduction of the BASH potential.

The necessary data is available and needs to be pruned and categorized for use by these managers. With the proper information available to them, the attitudes at base-level can change from "Wait until bird strikes become a problem," "We're going to fly anyway," or "It's not my job," to an attitude of responsibility with an emphasis on prevention.

II. Background Literature Review

Chapter 4 of this thesis will be a handbook for use by the base-level managers. In essence it will be a literature review of all of the information and techniques relevant for these managers, although it will not take the form of a literature review. Rather than present the same information twice, once in this chapter and once in chapter 4, only the information useful to all readers, such as background information relating the scope of the problem and insight into the general behavior patterns of birds, will be presented in this chapter. Thus, section one will provide a statistical basis for understanding the scope of the problem. Section two focuses on bird behavior and migratory routes. Section three will analyze the literature, and the fourth section will show the relationship between the problem and the literature reviewed.

Statistical History

As mentioned earlier, there have been many military bird strikes, but the civilian airlines and private aircraft have been similarly affected by bird strike activity. From 1970 to 1980, twenty-nine civilian aircraft were destroyed and fourteen people died as a result of bird strikes (4:10).

Most bird strikes occur at relatively low altitudes. Eighty percent of the recorded bird strikes occur from

zero to 3000 feet above ground level (AGL), with 37% occurring below 300 feet AGL (3:23). This statistic stems from two factors: birds routinely fly at these altitudes (when not migrating), and aircraft must pass through these altitudes when they take off and land. That is why 63% of all bird strikes occur around airfields, with 47% within ten miles of an airfield (3:23). The high percentage of bird strikes near airfields also occurs during takeoffs and landings, for then the aircraft engines run at high revolutions per minute (RPM). Thus, the engines literally suck in birds that are close to the aircraft (3:23). For example, a Convair 580 crashed and injured thirty people as a result of sucking a bird into an engine during takeoff (3:22). During other periods of flight, the engines are running at a lower RPM and probably would not suck in birds passing close to the engines.

Birdstrikes also occur during all phases of flight. A military study gave the following statistics for the percentage of bird strikes during each phase of flight (8:14):

Takeoff	17.9%
Climb (after takeoff)	1.9%
Cruise	4.7%
Descent	.98%
Range (munitions firing)	7.1%
Low level	14.6%

Unknown	28.79%
Final Approach	9.42%
Landing	13.0%

In the military, birds tend to hit certain aircraft more often than others, depending on aircraft size and mission. Fighter/attack aircraft experienced 39.4% of all bird strikes. Transport and tanker aircraft were second with 23.7% and trainers, bombers and other aircraft followed with 18.6%, 12.3% and 6% respectively (8:16). This topic will be addressed further, in the handbook.

All types of civilian and commercial aircraft were likewise affected by bird strikes. Birdstrike accidents ranged from small, privately owned aircraft to DC-10 jumbo jets (5:22). Such statistics show that all aircraft are vulnerable to bird strikes and that bird strikes can occur anywhere. As a result, much study has been devoted to understanding bird behavior, habitat, and flight patterns.

Bird Behavior

Because bird strikes are so potentially dangerous, many studies of bird behavior, habitats, and flight patterns were made to find methods of avoidance and ways to reduce the hazard.

With 63% of bird strikes occurring near airfields (3:23), studying the local habitat of birds living near airports was important. Studies of airfield environments found many factors attracting the birds. Proximity of the

airfield to water was important. New York's Kennedy International Airport is adjacent to Jamaica Bay. Because water is the natural habitat for some birds and because water is a source of food, there are always birds nearby (5:22). A DC-10 crash in 1975 resulted from birds being ingested into the engines on takeoff (5:22). Proper drainage at or near an airport is critical because poor drainage can cause flooding, resulting in the development of marshes, which attract birds. Thus, water as a natural habitat for aquatic birds, and as a food source, cause problems for airports located near water.

Other food sources attract birds as well. Dumpsites located near a base or airport cause problems. LaGuardia Airport is built on a dumpsite and across from a garbage transfer pier. Therefore, there are always a large number of scavenging birds around (5:23). Insects also can attract birds. Newark International had a problem with flocks of birds because of a thriving population of grasshoppers (5:23).

Migratory routes were of utmost importance to study because 20 million birds migrate each year (1:12). Birds follow four primary migratory routes: the Atlantic, the Mississippi, the Central, and the Pacific Flyways (1:12). The Atlantic flyway extends along the eastern seabord, while the Mississippi flyway extends from the Mississippi River down to Louisiana. The Central Flyway runs along

the Missouri River down to the Gulf Coast of Texas. Lastly, the Pacific Flyway includes the Lake Tahoe area, Central California, and continues into Mexico (1:13). While migrating, birds fly between 1500 and 6000 feet AGL. September through November are the peak times for migration activity; in fact, October historically has twice as many occurrences of bird strikes than any other month (1:13). Studies also showed that flocks of smaller birds were soon followed by flocks of larger birds (4:11). The springtime migration northward begins in late February, but is not as intensive as the fall migration to the south (1:13). Depending upon the species of bird, some fly at night while others fly in the daytime (1:13).

Shelter is another of the main reasons that birds are attracted to any location. Wide open areas, abundant at any airfield, can serve as a safe haven for birds to rest. When the grass is short, they feel safer because they can see predators approaching and because they can see the rest of the flock while they are on the ground. Trees can serve as the perfect roost or nest site. Even buildings can provide shelter and nesting areas.

Other information discovered about birds shows that their daily flying (not migration) is done mainly below 300 feet AGL (8:16). Also, a final characteristic noted about birds is that they tend to dive when scared (2:24).

With this knowledge of bird behavior, habitat, and

flight patterns, man has been able to devise ways to reduce local bird hazards.

Literature Analysis

All of the literature reviewed agreed that bird strikes pose a serious threat to all aircraft and passengers. For this reason detailed records and statistics have been kept for further study. The knowledge derived from statistics must be combined with information about bird behavior. Understanding bird behavior will help in the proper analysis of statistics and will provide the necessary framework for development of methods to reduce the hazard at or around airports. The results of these studies must be distributed widely. This knowledge will help to lessen the probability of bird strikes, but will do little to eliminate the hazard altogether. Thus, aircrews must be aware of the potential danger posed by bird strikes and prepare for the emergency in advance. Proper preparation and avoidance techniques will also aid in decreasing the probability of a bird strike, and perhaps lessen the severity of a collision. Furthermore, a model that can predict where the greatest hazards lie will be an invaluable addition to the other methods already in use for avoiding bird strikes.

The environment is constantly changing and so too are the habits and habitats of the birds. Similarly, training procedures and aircraft routing are changing constantly.

Thus, present methods for the reduction of bird strikes must also be reviewed constantly and changed to coincide with these changes.

Literature - Problem Relationship

The information provided by the literature review coincides with the scope and research objectives. For example, the statistics section shows the scope of the problem to the different base-level managers. Knowing that 80% of all recorded bird strikes occur from zero to 3000 feet AGL, with 37% occurring below 300 feet AGL, squadron managers can more effectively educate and train the pilots. Likewise, base operations can see that some type of bird watch and rapid takeoff/landing changes are necessary for preventing collisions. In the same manner, the information from each of the other four sections of the literature review can be categorized for use by the appropriate base-level managers.

Thus, this is the objective of our study: To take the information provided through research and categorize this information into handbook form so each base-level manager has a workable manual designed just for him/her.

III. Methodology

Introduction

The first part of our research involved completing an in-depth literature search and review. Our main sources of information include the following:

1. BASH Team and Library at Tyndall AFB, FL.
2. USAF Safety Office at Norton AFB, CA.
3. AFWAL Library at Wright Patterson AFB, OH.
4. FAA Office of Airport Safety, Washington, D.C.
5. Proceedings from the FAA sponsored Workshop on Wildlife Hazard to Aircraft
6. Professional and Safety Journals

We studied the extensive bibliographies maintained by these organizations that resulted from their numerous studies into the subject. From the sources, we identified further sources of information that pertain to our research goals.

Information Sources

The key bibliography maintained by the BASH Team at Tyndall AFB comes from a study entitled Frightening Devices for Airfield Bird Control by P. Defusco and Julius G. Nagy. It lists studies, documents and reports pertaining to pyrotechnics, pest control, and frightening devices. All of these can be categorized for use by certain base level managers. Another bibliography is a cumulative product of the BASH Team. It contains

approximately 500 entries. This too was studied with appropriate entries being researched further. The first study by Defusco and Nagy was completed in March 1983 and the BASH listing was updated in December 1983. Thus, both contain current material which is critical for comprehensive research. All of the sources listed on the BASH cumulative bibliography are kept at Tyndall AFB. A TDY was made to review the appropriate material and obtain copies for further study.

The USAF Safety Office at Norton AFB maintains current facts, figures and statistics on bird strikes throughout the Air Force. Our interest is in annual numbers of bird strikes, figures on annual dollar damage to aircraft, human injuries or fatalities, and a breakdown of bird strikes by aircraft and geographical region. This data helps to show trends that are significant to base level managers, such as increases in bird strike potential in a certain region during a certain time of year. Also, background data will help the base level manager to fully understand the critical nature of bird strikes and the importance that his/her efforts can make.

The Air Force Wright Aeronautical Laboratory (AFWAL) at Wright Patterson AFB examines structural effects of bird strikes on aircraft, such as how to modify an aircraft to limit damage as a result of a bird strike. Valuable knowledge for the base level manager (maintenance

or operations manager) may come from this source; for example, keeping windscreen heat on will make the windscreens more resilient to bird strikes. Also, a knowledge of AFWAL's function by base level managers will show them the importance of keeping good records and passing information useful to AFWAL (with respect to their function) back to the lab. An example would be base level maintainers who find that a critical panel or component should be shielded or strengthened. This information could lead AFWAL to design aircraft less susceptible to damage.

The FAA Office of Airport Safety gathers data obtained from all over the world. The study of commercial and non-U.S. points of view are important to finding new approaches and evaluating the success and failures of other organizations' attempts to reduce bird strikes.

Through the BASH Team we identified several bases that successfully dealt with bird hazards and studied the methods they applied, so that specific methods not already studied can be included in our manual. The BASH Team is an easy point of contact since they have helped many bases with local problems and can identify bases that have had the most noticeable success.

In May 1984, an FAA sponsored conference on wildlife hazards to aircraft was held in Charleston, S.C. We were able to attend and hear experts from around the world

discuss findings and give lectures about bird strikes, which is one part of the total wildlife hazard to aircraft. This TDY helped us to keep abreast of the newest, and great variety, of approaches to the problem.

Output

In order to make the handbook more useful we included the following:

1. Major BASH/bird strike terms with their definitions.
2. Listing of major USAF, Federal, and local agencies that deal with bird strikes.
3. Phone numbers for the appropriate agencies, such as AFWAL or BASH Team, so that individuals at base level can pass on suggestions or information from their area of expertise that may aid in future studies and research, or to ask for assistance from these agencies.

From the information gathered, we pruned redundant or irrelevant information from our data base. The remaining information was consolidated and put into handbook form for use by specified base level managers. The handbook remains general enough to apply to all bases. Checklists, procedures, and illustrations accompany the background information provided for each organization specified. We divided our information into four categories:

1. Maintenance
2. Civil Engineering
3. Base Operations
4. Airfield Management

Finally, at the end of our endeavors these managers will receive a comprehensive handbook tailored especially for his/her use.

Bibliography

1. "The Big Deployment," Tac Attack, 12-13. (October 1981).
2. "Birdstrikes: What can we do?," Tac Attack, 29. (October 1981).
3. "Bird vs Superbird," Tac Attack, 23. (October 1981).
4. Gillespie, Major James L. "Seasonal Hazard," Aerospace Safety, 10-12. (October 1980).
5. Graham, Frank Jr. "Confrontation in the Skies," Audubon Magazine, 22-23. (January 1983).
6. Long, Major Geral L. Chief, Bird/Aircraft Strike Hazard (BASH) Team. Personal interview. Tyndall AFB FL, 16 January 1984.
7. "Reporting and Recording Birdstrikes Leads to Prevention," TIG Brief, 6: 17-18. (13 March 1981).
8. Richardson, Major John E. "Birdstrike Report," Flying Safety, 14-16. (September 1981).

IV. A Bird Strike Handbook For Base-Level Managers

Introduction

Bird strikes (the collision between birds and aircraft) can affect military and civilian aircraft alike. The collision can result in aircraft damage or loss, as well as personal injury or fatality. From 1968 - 1984, thirteen military pilots were killed and sixteen aircraft destroyed as a result of bird strikes (Gillespie, 1980:10). The total for just 1982 came to \$14 million which included the loss of an F-16 aircraft (Long, 1984). A recent Air Force study also showed that approximately one out of six bird strikes is reported (Gillespie, 1981:17). In 1982 alone, 2300 bird strikes were reported in the U.S. Air Force. Therefore, as many as 13,600 bird strikes could have occurred in 1982.

These statistics vividly demonstrate the potential for disaster associated with bird strikes and the need to make accessible the vast amount of research conducted on bird strikes and bird strike prevention.

In an attempt to make Air Force base-level commanders and their personnel more aware of the bird strike hazards associated with flying, this handbook has been compiled to help "spread the word." Intended primarily for base-level managers, it has been written for the following organizations:

- Maintenance
- Civil Engineering
- Operations
 - schedulers
 - route planners
 - operations officers
 - squadron commanders
 - flight crews
- Airfield Management
- Safety
- Air Traffic Control

Much information on bird management control pertains to civil engineering and airfield management. Little information exists for maintenance. With respect to operations, safety, and air traffic control, numerous sources exist but are scattered throughout the literature. Until this project, no single document had yet combined the important elements from all these sources into a current, functional handbook that is useable at the field level and informative at the command level.

How To Use This Handbook

In order to disseminate information in the quickest way possible, the handbook has been divided into seven parts: one for each of the organizations mentioned above, and one entitled "Promising New Techniques." Each part is in turn subdivided into several sections. An overview

begins each part and then is followed by a background/general information section. As an aid to the reader a bibliography is located at the end of each part, as well as any figures and tables. In some cases there is an "information overlap" from part to part. This overlap helps to get the most important points across efficiently, to the specific users. Where more information could be helpful, readers are referred to other sections and parts. The "Promising New Techniques" section discusses programs in development that may significantly aid in reducing the bird strike hazard.

Bird Aircraft Strike Hazard (BASH) Plan

In order to guide bird management control activities and to minimize bird strikes when bird hazards arise, it is imperative that bases have a well-defined bird hazard reduction plan, better known simply as a base "BASH Plan." The plan should spell out in concise terms the responsibilities of the individual base agencies involved (BASH Team, 1983:1). Some bases have a recurring bird hazard problem, while others will have minimal concerns. Because the hazard involves a certain "unexpectedness," bases must be prepared ahead of time. Not all the potential problems can be predicted in advance, but preparation reduces the problems' impact. Because one of the main problems confronting bases is "lack of organization" (BASH Team, 1983:1), the construction of a

BASH Plan will help define potential problems, responsibilities of individual organizations, and areas where assistance will be needed. Assistance in preparing a base plan comes from:

BASH Team

HQ AFESC/DEVN

Tyndall AFB, FL 32403

(tel. AV/970-6240,6242)

A sample BASH Plan (the current base BASH Plan from MacDill AFB, Florida) is located in the appendix.

Bird Hazard Working Group (BHWG)

The base BASH plan is normally prepared by those individuals who are most concerned with bird management control. Collectively, they form the Bird Hazard Working Group (BHWG) and are members from the organizations mentioned previously in the introduction. Not only are the members responsible for drafting the BASH plan, they are also responsible for implementing it (BASH Team, 1983:2). Because each member views the problem(s) from a different perspective, it is important that ideas be shared freely and regularly. The frequency of meetings will be determined by the nature of the base bird hazard, and should be reflected in the BASH Plan. Suggestions on when and how to run BHWG meetings can be obtained from the BASH team.

A BASH Plan alone, however, will not keep the bird

problem away. The members within the BHWG must be dedicated, dynamic individuals who keep themselves informed throughout the year about:

- ecological changes in the airfield vicinity that might attract birds to the airfield
- bird strike events, problems, and possible solutions other bases use
- new developments in bird management control, both active and passive measures
- new developments in bird avoidance techniques
- new, potential problems to aircrews and recommended procedures and techniques to handle them
- new techniques to instruct and motivate those personnel who are responsible for executing the BASH Plan
- new instructional methods to inform flight crews about bird strikes

The above list is not exhaustive by any means and suggests that the bird strike problem requires imagination and foresight on the part of the members of the BHWG. The above list also suggests that the BASH Plan must be kept up-to-date to reflect the changes in base/local community ecology and changes in the base mission, such as replacing one type of aircraft with another.

Consequently, this handbook serves as a means for gaining an understanding of the problem, a source of

information for learning various techniques to deal with the problem, and as an aid in obtaining sources of further information to help those people who are determined to reduce the bird strike hazard at base-level.

Bibliography

Bird Aircraft Strike Hazard Team (BASH Team). Bird Aircraft Strike Hazard (BASH) Guidance Package. HQ Air Force Engineering and Services Center, Tyndall AFB FL, 1983.

Gillespie, Major James L. "Reporting and Recording Birdstrikes Leads To Prevention," TIG Brief, §: 17-18. (13 March 1981).

Gillespie, Major James L. "Seasonal Hazard," Aerospace Safety, 10-12. (October 1980).

Long, Major Geral L., Chief, Bird/Aircraft Strike Hazard (BASH) Team. Personal interview. Tyndall AFB FL, 16 January 1984.

Part I. MAINTENANCE

This section includes information relevant to maintenance operations. It is intended for all levels of maintenance, from the Deputy Commander for Maintenance (DCM) to the flightline workers. Crewchiefs, debriefers, trainers, inspectors, and supervisors will find current information relating to their functional responsibilities.

Contents

- A. Introduction
- B. Debrief
- C. Crewchief
- D. Initial Crewchief Training
- E. USAF Suggestion Program
- F. Conclusion

A. Introduction

Since 1968, thirteen military pilots have been killed and sixteen aircraft lost due to birdstrikes (Gillespie, 1980:10). The most recent losses have been a T-38 and an F-16. The T-38 hit a flock of birds upon takeoff, ingesting them into the engines causing dual flameouts which resulted in a crash and the death of the pilot. When the F-16 hit a pelican, the pilot had to eject from the severely damaged aircraft. The dollar amount in damage due to birdstrikes in 1983, a year when no aircraft were

lost, was still \$4 million. In other years the total has been as much as \$14 million (Long, 1984). For USAF aircraft alone, the total number of bird strikes in 1983 was at least 2300. All aircraft in the USAF inventory are vulnerable to birdstrikes, as figure 1 shows.

These statistics are presented to give a brief idea of the scope of the problem caused by birdstrikes and why it is necessary to pay attention to them. Attempts to reduce the problem involve a coordinated effort between the pilots, airfield managers, civil engineers, and maintenance personnel. All of these people have specific actions to carry out; yet they need an exchange of information for successful reduction of the number and severity of birdstrikes.

The maintenance actions are a part of this 'system' of hazard reduction. The actions to be addressed are critical and require not only repair of birdstrike damage but the gathering and reporting of data that is essential to pass on to the operations, safety and BASH personnel, in addition to detailed inspection and checks of the aircraft. The actions to be discussed here will be debrief functions, initial crewchief training, crewchief inspections, reporting and documenting, and the USAF suggestion program.

B. Debrief

The debrief function accomplished by the maintenance

personnel for aircraft status and incident reporting is one of the most important activities for helping to reduce bird strike incidents and severity. This is because valuable information gained from the aircrews at the end of a mission/flight can be recorded, such as:

- Location of bird strike
- Type of bird(s) involved
- Time of day
- Altitude
- Mission profile during the bird strike

This type of information can be used to determine hazardous areas of flight, hazardous times to fly, and can help establish a record for predicting heavy bird movement/migration times and paths. Thus, different low level routes can be flown to avoid these movements.

Information sent to the Wing Safety Office also must be detailed because it will be passed on to the BASH team at Tyndall AFB. They in turn will analyze the data from all bird strikes throughout the Air Force to document mishaps, to determine trends, to determine the vulnerability of certain aircraft, and to identify hazardous routes. If bird strikes occur near or at the airfield, the information will go through Wing Safety to the Airfield Manager and then to the Civil Engineering personnel who can take steps to remove the sources of attraction for the birds, thus reducing their numbers around the base.

Consequently, the need to communicate complete information to maintenance and all of these other agencies is imperative. The following information was determined by the BASH Team to be critical to various agencies and should be included on one, easy-to-fill-out form (Short and others, 1979:53). These items are:

- Squadron
- Aircrew
- Call Sign
- Date
- Local time
- Weather (also whether in, above, or below clouds)
- Light conditions
- Aircraft type and serial number
- Use of aircraft lights
- Phase of flight (i.e., takeoff, landing, cruise or mission)
- Mission type
- Aircraft speed (kias)
- Heading
- Altitude
- Geographic location (latitude/longitude)
- Low level route number
- Species and number of birds
- Impact point on the aircraft

- Bird activity (i.e., feeding or migrating)
- Evasive action taken by the pilot and/or by the bird
- Bird remains on the aircraft (yes/no)
- Damage to the aircraft (yes/no)
- Other remarks

A pre-made form, containing all of the information listed above, should be kept in the debrief section and used as required. The debriefer also needs to specifically ask if there were any bird strike incidents since near-misses or strikes with no damage are frequently forgotten and never reported. To aid the pilot in describing the location of a birdstrike on the aircraft, part of this form, or perhaps another form such as that shown in figure 2, can be used to circle or mark the areas of the aircraft that were struck by the bird(s).

Likewise, if the incident occurred on or near the airfield, a simple map of the area should be available in debrief to show where a birdstrike occurred or where dangerous bird concentrations are located. See figure 3 for a sample map (Short and others, 1979:50).

As an aid to determining the type of bird encountered perhaps a series of pictures can be obtained from the local U.S. Fish and Wildlife Service Office depicting local birds and migratory birds so that the pilots can correctly identify unfamiliar birds.

C. Crewchief

Because of the importance of the inspection done by a crewchief prior to and after each flight, very close inspection of the aircraft is necessary. Any new dent, blood smear or feather remains should spark in-depth inspection of the area. For example, if a dent or feather is found on, or in front of, an engine nacelle, then a thorough visual inspection of the engine by the crew chief and a borescope inspection by the engine specialists should be accomplished to insure no internal damage has been done. This is critical because 'suspected' bird strikes or bird strikes with no visible external damage have resulted in engine trouble and failure later in a flight or during subsequent flights. Similarly, a bird strike anywhere on the aircraft should trigger extensive inspection because a dent to the leading edge of the wing may have damaged hydraulic lines internally, or flight control cables, or wiring harnesses. The point is that a bird strike can cause a lot more damage to the aircraft than just cosmetic damage (visible damage such as a dent or hole in the skin of the aircraft), and it is this 'hidden' damage that must be checked closely.

That is why all bird strikes or suspected bird strikes must be written up in the 781 A, requiring an inspection and operational checks of the appropriate systems to be done and signed-off prior to the next

flight. The write-up serves as a record to help pinpoint the cause of subsequent failure or damage. The information also needs to be passed on to the debriefers so that it is preserved for bird strike studies made by base safety personnel and by the BASH team.

Air Force Regulation 127-4 requires that any bird strike that results in damage to an aircraft be reported to the BASH team, while AFR 127-15 requires that all non-damaging bird strikes be reported to the Wing Flying Safety Officer for semi-annual reporting to the BASH team. Both regulations list what information is necessary to include in the reports, including the address for the BASH team.

When the bird cannot be identified locally, any feathers (preferably downy feathers), feet, and bills if possible, should be sent for identification to HQ AFESC/DEVN Tyndall AFB, FL. 37403. The information required to include with the remains is:

- Organization requesting identification
- AFR 127-4 mishap control number
- Date of bird strike
- Type aircraft involved in the bird strike
- Description of damage to aircraft and cost
- Geographical coordinates (latitude and longitude) of strike

All of this information is in AFR 127-4.

The feathers or remains should be placed into a plastic "zip-lock" bag, and if they cannot be identified locally the "zip-lock" bag containing the remains could be placed into large pre-addressed envelopes kept in the debrief section.

D. Initial Crewchief Training

Because of the importance of the crewchief for discovering, inspecting, repairing, and reporting bird strikes, education about bird strikes should be included in both technical schools and in initial training once the new crewchief reaches his/her new base and learns about a specific aircraft. The maintenance training sections (MAT) and quality assurance/control (QA/QC) personnel need to discuss the scope of the problem, how bird strikes can affect an aircraft, and the importance of a thorough inspection and reporting of bird strikes. It is important that they realize that all aircraft are vulnerable, as figure 1 shows, and also that strikes can and do occur anywhere on the aircraft, as shown by table 1 (Kull, 1984:50,57).

Given the proper background and training, new maintenance personnel will know what procedures should be followed for a suspected or confirmed bird strike.

E. USAF Suggestion Program

The Air Force Wright Aeronautical Laboratory (AFWAL) located at Wright-Patterson AFB, Ohio, performs tests on

aircraft to determine the proper construction and materials needed to make them more resistant to damage from bird strikes. For example, they have designed a canopy for the F-16 aircraft that is more resistant to penetrations and deformations due to bird strikes. They are currently designing a new windscreen/canopy for the F-4 aircraft so that it too will be able to withstand a bird strike from a 4 lb. bird while the aircraft is travelling at 500 knots.

Maintenance personnel know from experience what type of damage is done to certain systems on an aircraft due to bird strikes and which systems are vulnerable to damage. Thus, they may have ideas on how to strengthen specific areas of the aircraft to protect these systems. Also, simply identifying critical systems that should be shielded from bird strikes is just as important. This type of information is important to the personnel at AFWAL and to the Major Commands. Simple and relatively inexpensive improvements to critical items may save many times the amount of money in damage prevented and possibly save lives as well. Therefore, maintenance personnel should be encouraged to fill out the A.F. Form 1000 to aid in the reduction of the severity of the bird strike hazard.

F. Conclusion

The Deputy Commander for Maintenance is responsible

for ensuring that personnel under his command have a knowledge of the hazard and the important part played by maintenance personnel in inspecting, reporting, and making suggestions that will make the hazard less menacing. A suggestion is that the personnel occupying the positions of Ground Safety Officer/NCO be tasked to insure that proper reporting is being accomplished in their respective sections, and squadrons. Quality Assurance and the Maintenance Training sections must likewise train and follow-up what they have taught.

BIRD STRIKES BY AIRCRAFT GROUP

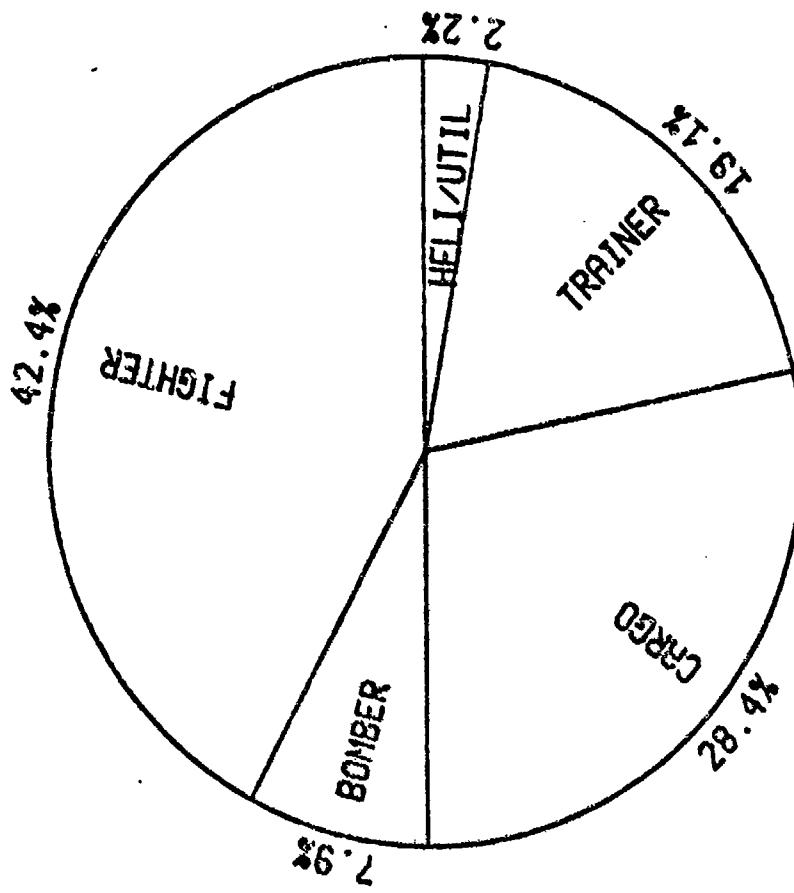


Fig. 1. Bird Strikes By Aircraft Group

DIRECTIONS:

-- Circle area(s) hit by bird(s)

-- List panel numbers affected

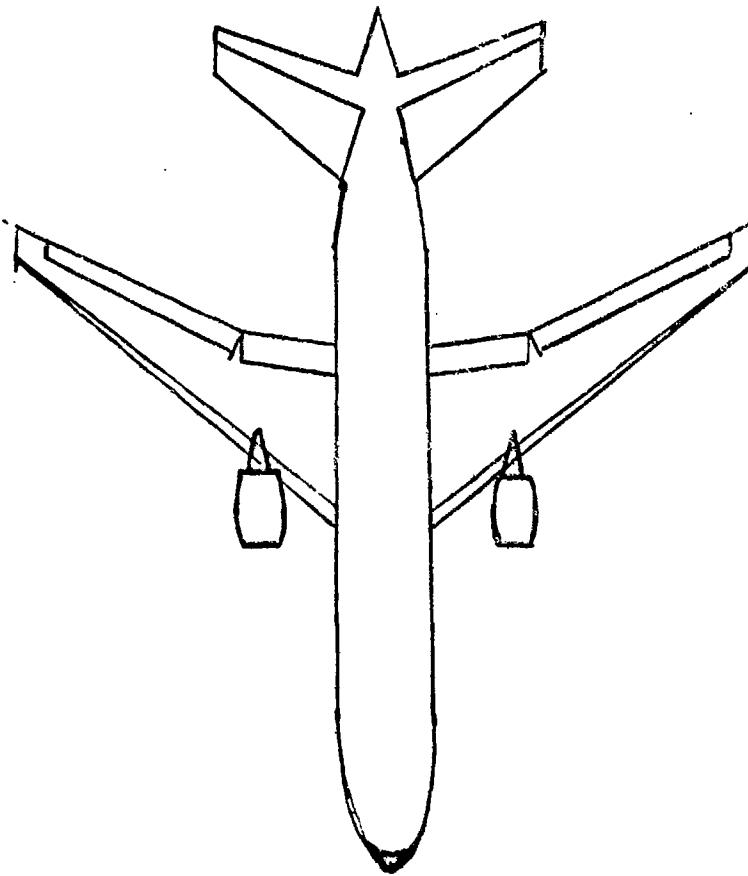


Fig. 2. Aircraft Pictorial for Reporting Bird Strikes

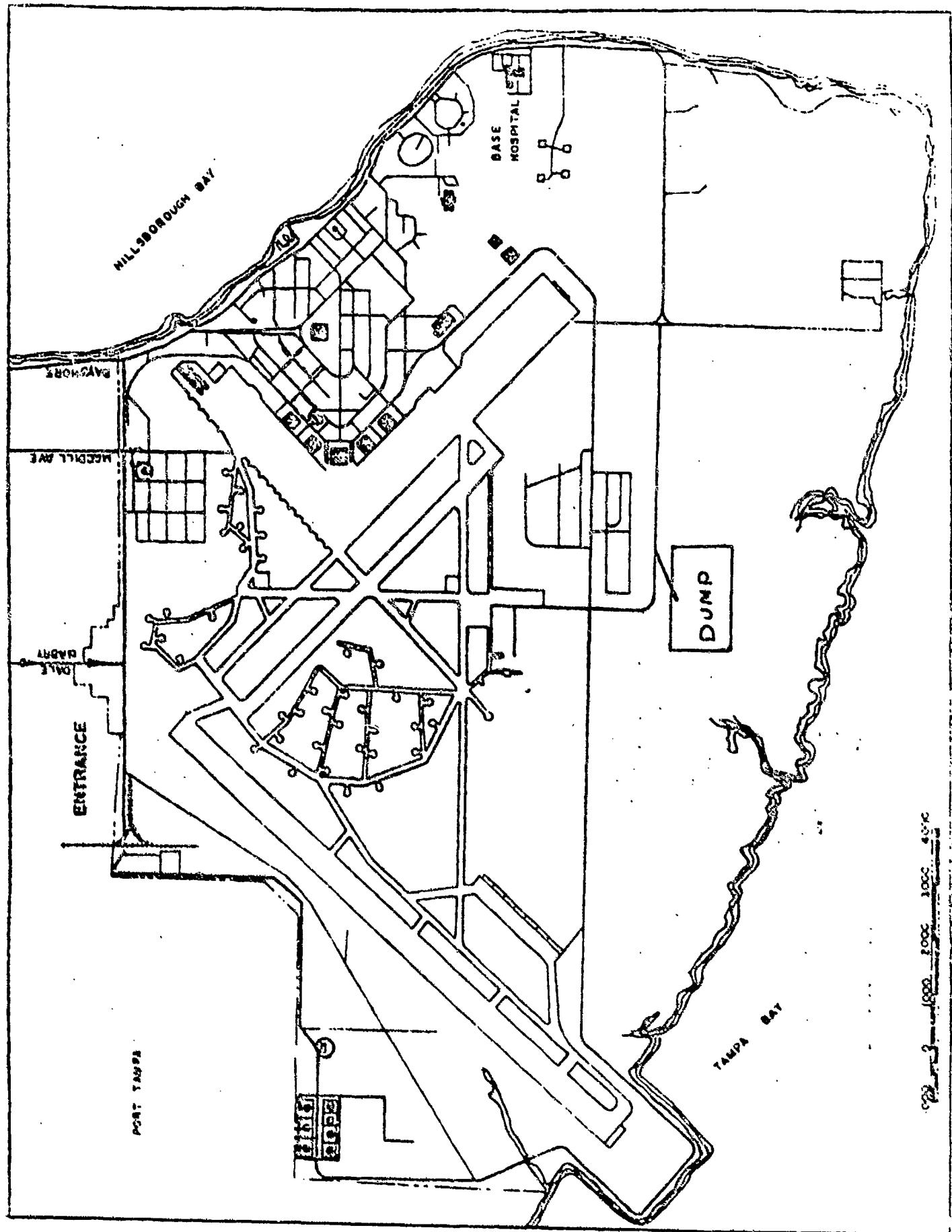


FIG. 3. Bird Activity Plotting Chart

TABLE I
Bird Strikes By Impact Point

<u>IMPACT POINT</u>	<u>PERCENT</u>
Engine/Engine Cowling	22.3
Windshield/Canopy	20.6
Wings	19.3
Radome/Nose	15.1
Fuselage	8.9
External tanks/pods/gear	6.7
* Multiple hits	5.2
Other	1.9

Bibliography

Gillespie, Major James L. "Seasonal Hazard,"
Aerospace Safety, 10-12. (October 1980).

Kull, Captain Robert C. Jr. "1983 Air Force Bird
Strikes," Proceedings: Wildlife Hazards to
Aircraft - Conference and Training Workshop.
49-57. National Technical Information Service,
Springfield VA, 1984.

Long, Major Geral L., Chief, Bird/Aircraft Strike
Hazard (BASH) Team. Personal interview.
Tyndall AFB FL, 16 January 1984.

Short, Captain Jeffery J. and others. An Evaluation of
the Bird/Aircraft Strike Hazard at Selected Pacific
Air Force (PACAF) Installations. Air Force
Engineering and Services Center, Tyndall AFB FL,
September 1979 (ADA075170).

Part II. CIVIL ENGINEERING

This section includes information relevant to civil engineering personnel. The current information relates to a wide variety of tasks performed by personnel holding various AFSCs.

Contents

- A. Introduction
- B. Edge Effects
- C. Grass Management
- D. Landscaping
- E. Pooled Water Removal
- F. Dumps/Sanitary Landfills
- G. Airfield Agriculture/Pasturing
- H. Insect/Rodent Control
- I. Chemical Treatment of Birds
- J. Additional Controls
- K. Conclusion

A. Introduction

Civil engineers have a definite role to play in a bird/aircraft strike reduction plan. Their efforts have a direct impact on the potential for dangerous birdstrikes on or near the base. Because 50% of Air Force bird strikes occur either at or near base (Kull, 1984:55), it

is imperative that serious effort be made to reduce the bird population near the base. Birds are attracted to the base by food, shelter, and nesting places. All of these attractants can be dealt with by civil engineering (CE) personnel.

The first order of business is to form and work with the Bird Hazard Working Group (BHWG) as discussed in section I of this chapter. By becoming familiar with the hazards and attractants, effective controls can be devised. Attractants result from edge effects, poor turf management, standing pools of water and/or sewage lagoons, sanitary landfills, agricultural land use, insect and animal pests, landscaping, wildlife refuges, and miscellaneous other reasons.

B. Edge Effects

The term edge effects refers to those areas on the base where vegetation changes from forest to brush, or brush to grass. Many animals are found in these areas. When small animals are present, raptors (birds of prey) are likely to be found. Thus, if animals live in the grass or brush, then the birds will be attracted to nearby trees. Also, brush (a thick growth of small trees and shrubs) around grass areas forms a likely area for birds to reside. A uniform cover will help to eliminate these problems (Long, 1983:20). If civil engineers are aware of what type of animals or birds are present in these areas,

proper actions can be taken to remove them. These measures will be covered in more depth in the following paragraphs.

C. Grass Management

Although the term 'grass management' sounds rather absurd, this topic is nonetheless important to reducing the bird strike hazard. CE personnel are responsible for mowing the grass on base. Thus, they are responsible for maintaining the proper grass height that will reduce the number of birds in the area, and hence reduce the possibilities of bird strikes. Flocking birds like to be able to see each other, and the area around them, at all times. But, if the grass is so tall that they are not able to see one another, or possible predators, while on the ground they will not remain. Tall grass also makes food harder to find for some birds, thereby keeping them away. The negative side of leaving the grass longer is that it invites rodent populations that attract raptors (birds of prey). Thus, a compromise must be made in grass height. Usually a grass height of 6 to 12 inches is best, depending upon land conditions, type of grass, and type of birds creating the hazard. Furthermore, the grass must be cut before the seed heads develop, otherwise grain-eating birds will be attracted (Long, 1983:20).

To aid in keeping the grass short without having to worry about mowing, which attracts the birds, growth

inhibitors are available that can be applied to areas that cannot be left long. Embark (mefluidide) is one such product. Application in the fall and spring will reduce needed mowings to only 3-4 per vegetation period. MH-30 (malein-acid-hydracide) and CF-125 (chlorflurenol) together create another inhibiting substance. Under normal weather conditions these chemicals, applied once in the springtime, result in a maximum grass length of 20-40 cm. An important note here is that the environmental impact of the chemicals must be known before use. In addition, with the grass being mowed less often perhaps a cost savings can be realized (Hild, 1984:197).

Different kinds of grass seed mixtures may provide suitable long or short grass length. Slow and short growing grasses can be mixed in different combinations for desired grass length or frequency of mowing. The type of soil and amount of precipitation will determine the proper type and combination of seeds as well. This method has been used successfully in the Federal Republic of Germany (Hild, 1984:197).

As stated earlier, one reason for various grass lengths is to keep the birds away from food sources in the grass, such as worms, insects, larvae, and grains. Chemical treatment to reduce these insects, rodents and other food sources will help in reducing the bird population. This method will be discussed in a later section.

Using proper grass mowing equipment is important for proper grooming of the grass. The equipment best suited for this is a wide rotary mower with an adjustable blade height of seven inches or more. A tractor-drawn, hinged, fold-out (batwing) mower (NSN 3750-00 828-1462 in TA 008) will do the job. It will be able to cut a swath from 5 to 25 inches and up to 15 inches in height (Long, 1983:20).

D. Landscaping

Landscaping a base or an airport is not only important from an aesthetic standpoint but for functional reasons as well. The functions may be noise suppression or division of areas. Yet, birds are attracted to many types of trees, bushes, and even buildings. Extreme caution must be exercised by not planting close to the runways, taxiways, or clear areas. Plantings can be a source of food and shelter for the birds and result in their flying at, near, or across aircraft flight paths. So, here are some rules for tree and shrub planting.

- 1) It is important to choose species of trees or shrubs that do not produce fruit (especially in wintertime). They are intense bird attractants since the fruit is a food source.
- 2) Plant trees far apart when they are young; otherwise they will grow together, resulting in one large continuous canopy. This dense foliage attracts

birds and is perfect for nesting and roosting (Long, 1983:21).

Trees planted anywhere on the base may be suitable for roosting. Even though the trees may be far removed from the active runways, they could still create a serious hazard. Starlings and blackbirds roost in large numbers. Millions of birds may inhabit a single roost. Since the birds in a roost usually all leave together at daybreak (within 10-20 minutes) and return together at dusk, the danger to aircraft is obvious when such large numbers of birds are moving together. Although starlings and blackbirds are small birds, the fact that they move in such density makes them extremely dangerous. In 1960 for example, an Electra on takeoff from Logan International Airport flew into a dense flock of these birds and crashed. Sixty-two people were killed. Similarly, in 1972 a Learjet crashed killing all seven people aboard because both engines stalled after ingesting blackbirds (Thorpe, 1984:32).

It may not be feasible to remove trees that provide roosts, but simply thinning the tree branches will reduce its attractiveness as a roost. With proper thinning, the trees will retain the same outward appearance and shade-providing ability, yet the small branches inside that were used as perches are now removed. This technique has proven successful in the past (Long, 1983:21).

Areas that have been replanted, or reforested, should insure that brush does not grow between the trees as this attracts wildlife that likewise attracts raptors. Thus, room should be left between trees to allow room for mowing (Long, 1983:21).

E. Pooled Water Removal

Another major attractant for birds is standing water. Standing water may be the result of improper drainage, or it may result from low spots that collect rain water. Standing water serves as a breeding place for insects and other types of food that birds like, as well as a place to rest. It also makes the grooming of grass impossible. Therefore, periodic checks for low spots will insure that drainage pipes and ditches are clear of objects hindering drainage. Furthermore, it is recommended that the ground around drainage ditches be graded to a 3:1 ratio. This will allow mowing up to the edge of the ditch (Long, 1983:21).

Ponds and sewage treatment ponds provide the same attractants as standing water. Here are a few more tips to reduce the hazard. First, since wading birds cannot feed in deep water, ponds should be constructed or modified so that they have steep sides and as little surface area as possible. Second, if possible, locate ponds far from runways and in a location such that birds traveling to the ponds do not cross runways.

(Long,1983:21). Third, string wires across the ponds to discourage birds from flying through the wires and landing there. The use of wires will be discussed in more detail in the next section. These ideas will help to reduce the attractiveness and the hazard.

F. Dumps/Sanitary Landfills

An Environmental Protection Agency (EPA) regulation prohibits landfills from being located within 10,000 feet of an active runway used by jet aircraft, if the dump will increase the number or likelihood of birdstrikes.

Although this regulation applies to non-military airports, it is a very good rule to follow. In fact, a survey made by the BASH team in 1980 showed that 50 Air Force bases had sanitary landfills located within 10,000 feet of active runways. Some states have taken it upon themselves to require Air Force bases located in the state to follow the same requirements as those stated in the EPA regulation (Long,1983:22). Even if the state does not require compliance with the regulation, bases would benefit from adopting this standard for themselves.

Before a landfill can be established, the state must issue a permit after proper hearings are conducted concerning the environmental effects. At this hearing CE, Airfield Management, and the base Staff Judge Advocate should discuss the bird hazard posed by dumps located too close to airfields. In one case, the Air Force persuaded

a city council to relocate a proposed dumpsite that was just outside the 10,000 foot requirement, yet still posed a substantial threat to air traffic (Long, 1983:22).

The less edible refuse exposed, the less attractive the landfill will be to birds. Yet, when trash is moved, smoothed, and compacted by a tractor bags are ripped open and garbage is exposed. Immediately covering refuse with dirt removes the potential food source. Since birds get accustomed to schedules refuse should be dumped at varying times to reduce the number of birds attracted at specific times.

As mentioned previously, wires strung above and across areas such as ponds or dumps can provide a psychological barrier to some bird species. Gulls seem most affected by the presence of wires and do not want to fly through them to reach open garbage (Solman, 1984:211). Studies have shown the effectiveness of wires strung above dump sites. The interval between the wires can be varied. Some tests have used spacing of 2.5 meters between horizontal wires while others use larger spacing (McLaren and others, 1984:242). In one particular study extreme reduction in the numbers of birds was found using wire spacing of 6 meters. When this same experiment used 12 meter intervals the birds became accustomed to the wire. Also, telescopic poles can be extended to maintain a certain height above the refuse as dump sites grow. They

also allow for experimentation with wire suspended at different heights. Again, a wire height of 10 meters was used successfully in tests (McLaren and others, 1984:243). Although monofilament can be used, wire is less likely to break when strung between poles for any length of time. To prevent birds from entering from the sides, below the wire grid, wire may be strung from the poles at lower levels around the perimeter of the site (McLaren and others, 1984:243). As a final note, young birds are more likely to enter than older birds. Thus, in late summer (after breeding time) more younger birds may be present.

Keep in mind the tradeoff between the cost of bird strike damage, the relative danger posed by the birds, and the cost of erecting this wire cover. For example, if the bird strike hazard is not severe, it may cost far more to erect and maintain a wire grid than it would to simply repair the damage to the aircraft. Yet, this type of tradeoff must be weighed when deciding upon the use of any method for reducing the bird hazard.

G. Airfield Agriculture/Pasturing

In many cases extensive land on the airfield may be used for pasturing or for cultivation. Although it may be efficient use of the land, these activities may contribute to the attraction of birds. Here is why. When the earth is plowed, many worms, insects and other types of food are exposed to the birds. Depending upon what is planted, the

crop" may yield edible food for the birds as well. Some crops are potentially more dangerous in the number of birds they attract. For example, when grain crops are harvested, the exposed grain is ready to eat and available to the birds. On the other hand, hay, alfalfa, cotton and flax are less attractive (Long, 1983:22). It would be too lengthy a discussion here to recreate the work of experts regarding all of the different crops and the number and type of birds attracted to these crops. Thus, recommended reading on these specifics can be found in an article entitled "Birds and Airport Agriculture in the Conterminous United States: A Review of Literature," in the proceedings published by the FAA entitled, Wildlife Hazards to Aircraft: Conference and Training Workshop, May 1984.

If airfield crops are significantly different from those crops in the surrounding area, then birds may be attracted to the unique crops. Also, if harvesting of airfield crops is done before or after the surrounding crops, a large influx of birds may seek the more intense food source, whether it be insects or grain. Thus, planting the same crops and harvesting them at the same time as crops in the neighboring community will help to eliminate unusually large groupings of birds (Long, 1983:22). Reducing the hazard of bird strikes is a cooperative effort. For this reason, any agricultural

work should be coordinated with Airfield Management, so work that may increase the bird population can be scheduled during times of minimal flying activities (Long, 1983:22).

All of these hazards may exist at fields bordering, but not owned by, the airfield. In cases like these, discussion of the hazard with the land owner may provide some solutions or concessions. This leads into an important point. It may be necessary to coordinate and cooperate with people or agencies off the base itself, such as the FAA, U.S. Fish and Wildlife Service, or private citizens.

H. Insect/Rodent Control

Insects and rodents are food sources for birds. Reducing or eliminating this source forces the birds to look for food and reside elsewhere. One method of doing this is for CE to use chemical control. Insecticides can be used to control grasshoppers or other insects, while rodenticides can control the small animals. The Military Entomology Operational Handbook (AFM 96-16, Dec. 1971) may be consulted for proper insect control (Lucid and Slack, 1980:71). As a reminder, only EPA approved chemicals may be used, and only according to label instructions (Long, 1983:22).

After rainfall, worms may be present on runways. Therefore, when practical, a sweeper could be used to

clean runways before further flying is done, so that scavenging birds will not gather. Inspections made on a regular basis, all around the base, can find insect or rodent infestations that cause the birds to gather.

I. Chemical Treatment of Birds

Just as chemicals can be used to control the birds' food source, the chemicals can be used to control and repel the birds themselves. For example, sticky repellent (Polybutenes) can be sprayed anywhere birds perch. It gives an uncomfortable feeling to the birds and in some cases a mild burning sensation. This substance can be sprayed on roofs, beams, and other perch sites around buildings, as well as on trees or airfield structures such as runway markers, antennas, and radar reflectors (Lucid and Slack, 1980:88).

Psychological repulsion can be used with the help of Avitrol (4-Aminopyridine). This substance can be applied to grain or bait. When the birds eat the food laced with Avitrol, they give distress calls which frighten the other birds away. This technique can be used for gulls, starlings, sparrows, and pigeons. One note of caution is that pre-baiting may cause flocking, hence a strike hazard. Furthermore, since starlings do not usually eat near their roosts, baiting in this area may actually attract them to the roost. Lastly, using this technique of repulsion is more effective on large, rather than small, flocks of birds (Lucid and Slack, 1980:82).

As a last resort, killing the birds with chemicals is an option, yet the potential adverse public reaction must be dealt with. This procedure is best for immediate rather than long term results because other birds will return eventually. The use of Avitrol (4-Aminopyridine) in small doses can cause abnormal behavior as previously discussed. In larger doses, it is lethal to the birds. The same technique of pre-baiting is accomplished; only more Avitrol is used (Lucid and Slack, 1980:105).

Starlicide (3, chloro-p-toluidine hydrochloride or Compound DRC-1339) is another lethal chemical used to control starlings and blackbirds at livestock and poultry feedlots. It is registered for use only in these areas. Thus, if a feedlot is close to the base or if large roosts of birds feed there, this procedure may be beneficial (Lucid and Slack, 1980:106).

Wetting Agents (Compound RA-14 Stressing Agent or Tergitol) can be used as a lethal means of bird control. The chemical is sprayed on the birds and causes the oil on their feathers to wash off. When used in cold, wet weather, the result is exposure and death. A disadvantage to this procedure is that wetting agents are costly, hard to apply, and many times do not yield success. Furthermore, this method of control can only be used in cooperation with the U.S. Fish and Wildlife Service to

reduce the hazard posed by starling and blackbird roosts (Lucid and Slack, 1980:109).

In any use of chemicals, only trained personnel with the proper equipment should be allowed to perform these tasks.

J. Additional Controls

This section is nonetheless as important as other sections. The following topics just did not fit nicely into other categories.

Control of Birds In and Around Buildings.

Buildings can provide birds with shelter and food. For this reason precautions need to be taken to prevent buildings from becoming a haven for birds. Beams, roofs, ledges, and ceilings can be used as shelters, perches, nests and food sources. Pools of water on the roof also draw insects which in turn attract birds. For these reasons, buildings must be treated just as the trees and landscaping were. Perches, shelter, nests and food must all be eliminated. Flat roofs without proper drainage can cause pooling which must be corrected. Roof overhangs provide another area where birds can enter and nest. Wire screening placed there will keep the birds from entering. Any type of ledge on the building can be a potential perch site. Thus, sharp projectiles can be placed there to prohibit the birds from being able to sit or stand (see figure 1). (This same technique can be used anywhere on

the base to eliminate perch sites such as runway markers, antennas, and radar sites.)

Many times birds enter hangars to perch and to take insulation for nesting. Lowering the ceiling to the bottom of the beams and using a type of sheet metal roofing eliminates this problem. For a detailed discussion of the methods and materials to keep birds out of hangars, see the Air Force Civil Engineering Center's 1976 report entitled, Consultation Report: Grissom AFB Hangar 200. This is a good reference for ideas to use, specific procedures, and approximate costs.

Trapping and Relocating Birds.

Trapping certain species of birds and relocating them is one possible way to eliminate some hazards. It is also more acceptable to the public than killing the birds. But, a problem with this method is that it is not feasible for large numbers of birds located over a large area.

The traps should be placed in an area where they will not be disturbed. Bait should be placed inside and around the traps (food appropriate for the type of species to be caught), with plenty of water available. For example, pigeons like whole corn, House Sparrows like finely cracked corn, and Starlings like cracked corn also, along with apples or peanut butter. A check of the traps must be made daily. Birds must be transported at least 40 miles before being released so that they will not find

their way back to the base (Lucid and Slack, 1980:95). Types of traps vary according to number and type of bird being sought. Specific information is available in the Handbook on Bird Management and Control dated March 1980, by Lucid and Slack.

Trapping birds by netting them is possible using cannon nets, mist nets, or the floodlight net trap; however, these methods are usually not going to remove enough birds to stop the hazard. But, in certain circumstances they are appropriate and effective, which is why they are mentioned here.

Nest Destruction.

Destroying nests must be accompanied by some form of permanent type of exclusion technique such as pruning trees or putting wires or screens on accessible areas in buildings to keep the birds from coming back and re-nesting. Also, a permit is necessary before destroying the nest of an endangered species.

Wildlife Refuge Location.

Wildlife refuges pose a significant problem for some bases since many bases are located away from population centers and near land that supports many forms of wildlife. Thus, a hazard may be present due to the proximity of the birds and aircraft. The U.S. Fish and Wildlife Service or state agencies conduct meetings before any refuges are specifically located to see if there are

any potential problems with the location. Any objections to the location of the refuge should be discussed at these meetings (Long, 1983:22).

Visual Repellents.

Visual repellents such as scarecrows or plastic snakes, or lights are not good repellents since birds quickly become accustomed to these.

K. Conclusion

The Chief of Civil Engineering at the base has many methods for reducing the bird strike hazard. In conjunction with the other members of the BHWG, he must decide what measures are necessary in relation to the actual cost of bird strike damage or potential hazards. Control of the birds is a never ending job. Constant follow-up of results and checking for new hazards or problems requires that periodic checks be made of the threat and of the efforts to combat the threat. A very comprehensive checklist is provided at the end of this civil engineering section that will help in assessing the problems. It also comes from the Handbook on Bird Management and Control previously mentioned. Another important checklist was developed by the BASH team and is also included at the end of this section. It is a self-inspection checklist that asks questions pertaining to all of the organizations involved in bird hazard reduction (the BHWG), but serves as a very useful tool for

the CE manager as well. It comes from the BASH Guidance Package.

Personnel doing the actual inspections and implementing the various methods of reduction should be skilled, should be dedicated, and should maintain the same job for as long as possible. It takes a dedicated individual who has learned the many techniques, learned the various species of birds, is aware of the ongoing programs, and knows what has been done that requires follow-up. Whereas military personnel leave after 2-3 years, civilian personnel can remain for extended periods of time. Thus, the delegated manager of the CE program for bird hazard reduction should be a civilian worker. He/she would already know the trends, methods, what was done, and who to work with on and off the base.

Since it is extremely important to work with people from on and off base, a spirit of cooperation is crucial. As mentioned already, the FAA, the EPA, the U.S. Fish and Wildlife Service, the BASH team, and the State and local governments can help, and are involved in the preventive efforts. A knowledge of these many contacts and their function in dealing with the bird strike problem is also a reason for having one person who does not PCS every few years running the program.

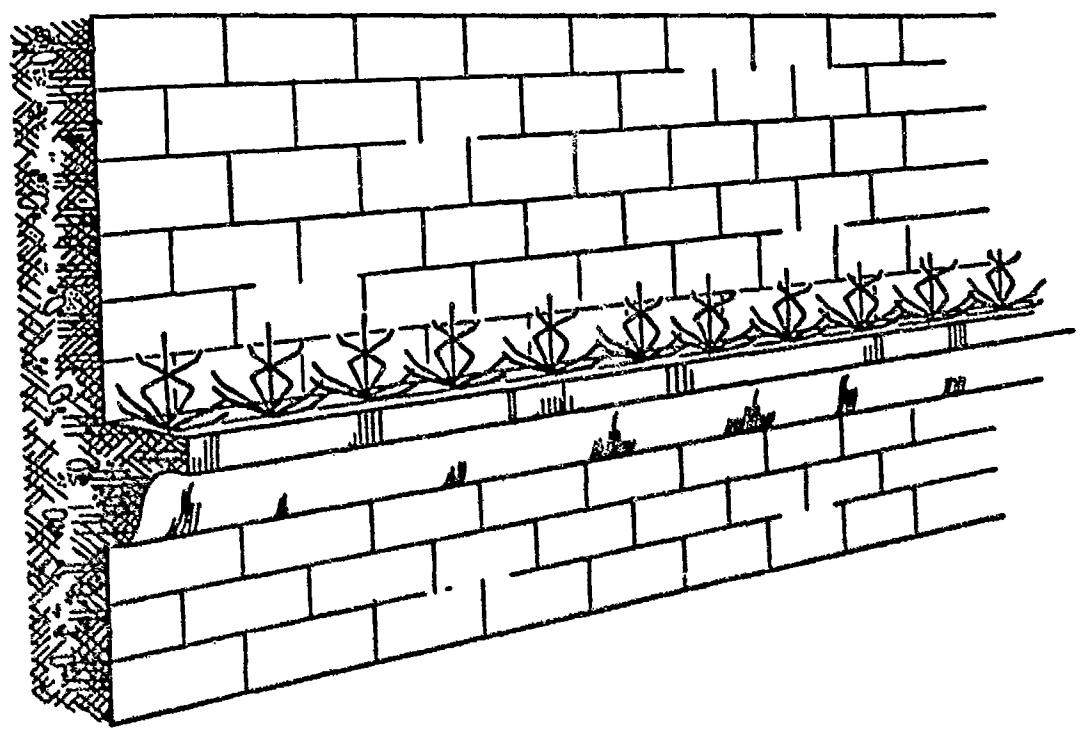


Figure 1. Sample application of sharp projections.

TABLE I
Base Self-Inspection Checklist

NO.	ITEM	YES	NO	N/A
1.	Is AFR 127-4 current and readily accessible for your reference?			
2.	Is AFR 127-15 current and readily accessible for your reference?			
3.	If the base has a flying mission, has a BASH reduction program been established?			
4.	Does the program establish a Bird Hazard Working Group (BHWG) or similar organization?			
5.	Are base agencies such as Safety, Civil Engineering, and Operations assigned responsibilities for the BASH program?			
6.	Is there an assigned OPR of the BHWG?			
7.	Does the BHWG meet on a regular basis as a separate meeting or in conjunction with another meeting containing the same members?			
8.	Are flight safety briefings to the aircrews accomplished on a regular basis?			
9.	Are topics for the briefings varied so as to make them interesting and informative?			
10.	Are different types of media used in the briefings (e.g., movie, slides, personal testimony, statistics)?			
11.	Are posters, pictures, maps, etc., related to BASH posted in the aircrew briefing areas?			
12.	Are local bird problems documented?			
13.	Are both damaging and nondamaging bird strikes recorded?			
14.	Is all the information concerning the bird strike as listed in AFR 127-15 recorded?			

TABLE I (Cont.)

NO.	ITEM	YES	NO	N/A
15.	Are all nondamaging bird strikes reported to HQ AFESC/DEVN, Tyndall AFB FL 32403, semiannually?			
16.	Are all damaging bird strikes reported with all the proper addresses?			
17.	Are bird remains (feathers, beaks, feet) collected as a result of a bird strike?			
18.	Are bird remains sent to a local authority (US Fish and Wildlife Service, University, or ornithologist) for identification?			
19.	Are bird remains sent to HQ AFESC/DEVN at Tyndall AFB if identification is not possible in the local area?			
20.	Is the bird strike information tracked so as to facilitate the identification of trends (e.g., type of bird, route, time of day, type of aircraft)?			
21.	Are statistical analyses of bird strike data accomplished?			
22.	As part of the bird awareness program, do you have a bird identification book?			
23.	Are daily surveys taken of the airfield and surrounding area to observe potential/actual bird hazards?			
24.	Are the daily surveys taken at various times of the day?			
25.	Are records of daily observations kept in order to establish trends?			
26.	During the surveys, are areas like standing water, food sources, or areas for protection noted?			
27.	Is the vegetation on the airfield particularly attractive to birds?			
28.	Does the base have agricultural contracts (outleases) to mow the airfield?			

TABLE I (Cont.)

NO.	ITEM	YES	NO	N/A
29.	Does the contract specify that the grass be maintained at a height of 8-12 inches?			
30.	Does the base practice controlled burning?			
31.	If controlled burns are practiced, are changes in operations done or burning accomplished during down times?			
32.	Are trees or shrubs located within 1000 feet of the runways?			
33.	Are these trees/shrubs attractive to birds?			
34.	Are birds attracted to the taxiways or active runways?			
35.	Has it been determined why the birds are attracted to the taxiways/runways?			
36.	Has it been determined what type of birds are attracted to the taxiways/runways?			
37.	Are the areas with water (ponds, lakes, swamps, etc.) attractive to birds?			
38.	Are the birds feeding in these wet areas?			
39.	Has it been determined what type of birds are attracted to these wet areas?			
40.	Do the wet areas contain vegetation along their perimeters?			
41.	Do the wet areas contain fish or amphibians (frogs or salamanders)?			
42.	Are there other areas near the runways that attract birds (horse stables, recreation areas, golf courses, etc.)?			
43.	Has it been determined what is attracting the birds?			

TABLE I (Cont.)

NO.	ITEM	YES	NO	N/A
44.	Has it been determined what type of bird is being attracted to these other areas?			
45.	Are there farms in the surrounding area of the base that attract birds?			
46.	Has the farmer been approached by the base and asked to change crop to eliminate the attractiveness of the area?			
47.	Is the base notified by the farmer of the plowing times in order to alter operations?			
48.	Does the farmer practice controlled burning after harvest?			
49.	Does the base outlease cropland on adjacent areas?			
50.	Does the lease provide for restrictions concerning BASH?			
51.	Are there garbage dumps, landfills, or sewage lagoons in the area near the base?			
52.	Is the garbage dump/landfill/sewage lagoon covered daily with dirt/wire or netting?			
53.	Does the garbage dump/landfill/sewage lagoon attract birds?			
54.	Are there other areas attractive to birds near the base (e.g., lakes, ponds, swamps, cemeteries, wildlife areas)?			
55.	Have aircraft hangars/buildings been inspected for pest birds?			
56.	Do bird droppings cause problems for equipment/aircraft?			
57.	Is equipment covered and aircraft cockpits closed each night to provide protection against bird droppings?			
58.	Are hangar doors left open all the time?			

TABLE I (Cont.)

NO.	ITEM	YES	NO	N/A
59.	Is the cost of cleaning up the bird droppings and any damage incurred less than any type of solution to the problem?			
60.	Is there an active hunting club on base?			
61.	Are the game birds/deer controlled so as not to interfere with flying operations?			
62.	Does the control tower warn operations/pilots of birds in the airdrome?			
63.	Is there a designated bird control team that actually manages/controls birds?			
64.	Is the control team actively patrolling the airdrome?			
65.	Does the control team use distress tapes to reduce bird populations on the airfield?			
66.	Does the control team use pyrotechnics?			
67.	Is Avitrol or other avicide used to control/kill birds?			
68.	Does the control team possess a permit issued by the US Fish and Wildlife Service to kill birds?			
69.	Have state authorities been notified concerning the depredation permit?			
70.	Are traps used to capture birds?			
71.	Does the BHWG suggest ways of altering the situation or changing the habitat to discourage birds from the area, before using elimination/reduction techniques?			

TABLE II
CHECKLIST FOR SURVEYING A BIRD PROBLEM

<u>Location</u>	<u>Survey Conducted by:</u>	<u>Date:</u> _____ <u>Time of Day:</u> _____	<u>Weather Conditions:</u> _____	<u>Present on Base</u>	<u>Inspected</u>	<u>Comments</u>
1. Types of Habitat						
a. Aircraft hangars	()	()	()	()	()	()
b. Housing area	()	()	()	()	()	()
c. Other buildings	()	()	()	()	()	()
d. Landfill	()	()	()	()	()	()
e. Parklike landscaped area	()	()	()	()	()	()
f. Agriculture	()	()	()	()	()	()
g. Runways and/or grassy field	()	()	()	()	()	()
h. Brushland	()	()	()	()	()	()
i. Forest	()	()	()	()	()	()
j. Forest plantation	()	()	()	()	()	()
k. Marsh	()	()	()	()	()	()
l. Pond	()	()	()	()	()	()
m. Stream or drainage ditch	()	()	()	()	()	()
n. Shoreline or mudflats	()	()	()	()	()	()
o. Other (specify)	()	()	()	()	()	()

2. Building Features to Inspect for Evidence of Pest Birds

TABLE II (Cont.)

Type of Evidence	Droppings	Nest Material	Birds (list species and numbers)	Comments
	(X)	(X)		
a. Rooftop	()	()		
b. Roof edges or firewalls	()	()		
c. Window ledges	()	()		
d. Other outside ledges	()	()		
e. Underneath eaves	()	()		
f. Air conditioners	()	()		
g. Ventilators	()	()		
h. Chimneys	()	()		
i. Gutters and downspouts	()	()		
j. Holes or construction flaws	()	()		
k. Signs	()	()		
l. Antennas	()	()		
m. Ornamental features	()	()	(+)	
n. Other outside features	()	()	(+)	
o. Beams and rafters	()	()	(+)	

TABLE II (Cont.)

Type of Evidence

Droppings	Nest Material	Birds (list species and numbers)	Comments
(X)	(X)		
p. Inside ledges	()	()	
q. Inside corners or recessed areas	{ }	{ }	
r. Insulation	{ }	{ }	
s. Other inside features (specify)	()	()	
t. Equipment (specify)	()	()	

TABLE II (Cont.)

3. Other Evidence of a Pest Bird Problem
 - a. Reports or complaints. (Give details and means of verification).
 - b. Birds observed loafing on or near runway. (List species and numbers).
 - c. Birds observed feeding on or near runway. (List species, numbers, and food being taken).
 - d. Birds crossing flight path of planes. (List species, source and destination of birds).
 - e. Other. (Specify).

4. Summary of Birds Observed

TABLE II (Cont.)

<u>Species</u>	<u>Numbers seen</u>	<u>Habitat in which seen</u>	<u>Activity (feeding, nesting, roosting, flying)</u>
Pigeon			
Starling			
House Sparrow			
Protected species (list)			

TABLE II (Cont.)

5. Are any of the birds listed in (4) causing economic damage or creating a health or safety hazard?

If so, list species and type of damage or hazard.

6. What is attracting the problem birds to the area?

- a. food
- b. water
- c. a place to nest
- d. a place to escape enemies or avoid harsh weather (includes roosting and loafing areas).
- e. A combination of the above. (Specify which).

7. How long has the problem existed?

8. What season(s) of the year is there a problem?

9. Is the problem being caused by resident birds or transient birds?

TABLE II (cont.)

10. What time(s) of day is there a problem? (Make a graph by plotting numbers vs. time of day.)
11. Are the birds developing a pattern dependent on weather (e.g. gulls loafing on the runway in overcast weather)?
12. Does the situation warrant the time and expense of an active management program? What would probably happen if no action were taken at this time?
13. List control techniques previously applied or attempted. If unsuccessful, list reasons for failure.

Bibliography

Hild, Jochen. "Landscape Management of Airports for Reduction of Bird Populations," Proceedings: Wildlife Hazards to Aircraft - Conference and Training Workshop. 195-206. National Technical Information Service, Springfield VA, 1984.

Kull, Capt Robert C. Jr. "1983 Air Force Bird Strikes," Proceedings: Wildlife Hazards to Aircraft - Conference and Training Workshop. 49-57. National Technical Information Service, Springfield VA, 1984.

Long, Major Geral L. "CE's Role in the BASH Reduction," Engineering and Services Quarterly, 20-22. (Winter 1983).

Lucid, Vincent J. and Roy S. Slack. Handbook on Bird Management and Control. Contract F08635-77-C-0377. HQ Air Force Engineering and Services Center, Tyndall AFB FL, March 1980.

McLaren, Margaret and others. "Effectiveness of an Overhead Wire Barrier in Deterring Gulls from Feeding at a Sanitary Landfill," Proceedings: Wildlife Hazards to Aircraft - Conference and Training Workshop. 241-252. National Technical Information Service, Springfield VA, 1984.

Solman, Victor E. F. "Reducing Gull Use of Some Attractions Near Airports," Proceedings: Wildlife Hazards to Aircraft - Conference and Training Workshop. 209-212. National Technical Information Service, Springfield VA, 1984.

Thorpe, John. "Accidents and Serious Incidents to Civil Aircraft Due to Birdstrikes," Proceedings: Wildlife Hazards to Aircraft - Conference and Training Workshop. 25-36. National Technical Information Service, Springfield VA, 1984.

Part III. OPERATIONS

This section includes information relevant to flight operations and is intended primarily for pilots and other aircrew members. Schedulers, route planners, operations officers, and squadron flying safety officers will also find pertinent data and information relating to their operational responsibilities.

Contents

- A. Background/General Information**
- B. Scheduling, Route Planning and Bird Avoidance Model (BAM)**
- C. Mission Planning**
- D. Pre-takeoff Briefing, Preflight, and Taxi**
- E. Takeoff and Departure**
- F. Inflight - Cruise**
- G. What to Expect: Windscreen Penetration and Engine Ingestion**
- H. Actions to Take**
- I. Approach and Landing**
- J. Traffic Pattern**
- K. Postflight**
- L. Reporting Procedures**
- M. Bird Strike Avoidance Training**
- N. Bird Strike Statistics (1983 and 1980-82)**

A. Background/General Information

In addition to accomplishing the mission, aircrews are probably most interested in not sacrificing safety in the least. Bird strikes can happen at any time of year and during any phases of flight (Schultz, 1984:18). For these reasons, crews should know a little about bird behavior, where and when strikes occur, and what aircraft are affected. Most important, however, one must use good judgment in evaluating bird strike data, because bird strikes do not occur often enough to be topics of everyday concern for most pilots and crewmembers. On the other hand, strikes do happen often enough that damage for the Air Force amounts to about five million dollars per year. Further, the bird strike phenomenon must be put into its proper safety perspective with respect to operational requirements (BASH Team, 1983:11). For the most part, bird hazards to aviation are peacetime concerns. During periods of increased national readiness or contingency operations bird strike concerns would receive a much lower safety priority.

The Air Force is concerned with ways to minimize bird strike damage and to prevent aircrew injury. Crews should be interested in the methods that can be accomplished to (BASH Team, 1983:11):

-- Improve safety

-- Reduce costly repairs

-- Protect aircrews

Because bird strikes have caused major damage to aircraft as well as pilot injury and death, the Air Force created the Bird Aircraft Strike Hazard (BASH) Team (Kull, 1983:4). Located at Tyndall AFB, Florida, the BASH team has collected bird strike data since 1975, and their statistical findings have established some useful trends. Section N contains the statistics from 1980-83. Most bird strikes (67%) occur during the day, because most Air Force flying is done during that time (Kull, 1984:50). Night operations involve about 18% of all bird strikes, and twilight hours only 5%, with the remaining 10% listed as unknown. (See Figure 1)

Most bird activity occurs during the early morning hours and again during the late afternoon and early evening. This daily activity happens because birds are interested in mainly three things: food, water, and shelter (Solman, 1984:2). The bird numbers increase significantly twice each year, once during the spring migration to the north, for breeding purposes (March - June), and again during the fall migration to the south (August - November). The fall migration is the more pronounced one, since bird populations, now with offspring, reach their largest numbers at this time. Records show that as the fall migration peaks in October,

so do the number of bird strikes. But, interestingly enough, day strike numbers only increase moderately, whereas the number of night strikes rises significantly (Kull, 1984:51). This increase is attributed to the characteristic nocturnal migration of most birds, which begins shortly after dusk.

Almost 50% of all bird strikes occur within 10nm of a base, or basically within the confines of the local traffic pattern (Long, 1984). Another 25% of strikes are associated with low-level training, most of which is conducted at high speed (350-500 knots) and at altitudes of 1000 feet AGL or less. (See Figure 2)

Even though bird strikes have been reported as high as 33,000 feet (Harrison, 1984:9), over 90% of Air Force strikes takes place at altitudes of less than 3000 feet AGL (Kull, 1984:56). Of that percentage, most of those occur at or below 500 feet AGL. (See Figure 3)

Although any part of an aircraft is susceptible to a bird strike, two areas are critical (Kull, 1984:50): engines/engine cowlings (22.3%) and windshield/canopy (20.6%). In the first case, engine ingestion may result, while in the second case, a canopy/windscreen penetration may occur. In either situation, the aircrew is vulnerable to a possible crash or even a fatality. Of the bird strikes that involve windshields/canopies, only five percent manage to penetrate the canopy. Of interest to

aircrews is the small percentage (5%) of strikes that involve multiple hits. Needless to say, this occurs because certain species, such as gulls, waterfowl, and blackbirds, frequently fly in flocks (See Table 1).

As might be expected, fighter aircraft experience the most strikes -- about 42% (Kull, 1984:52). This occurs because fighters spend more time at lower altitudes, much of it at high speed and at or below 500 feet AGL. Two other categories of aircraft also spend time low levels; so cargo aircraft receive about 28% and bombers 8% of the bird strikes. Trainers experience about 19% with the remaining small percentage associated with helicopters and utility aircraft (See Figure 4). For a listing of bird strikes by aircraft (based on 1980-82 data) see Table 3. Again, as might be expected, the aircraft that have a low-altitude mission have the higher strike rates. Aircraft in this category include A-10, B-52, FB-111, and F-4.

To get an idea of which species of birds are involved in bird/aircraft strikes, refer to Table 2. As can be seen 52% remain unknown as far as species or size of bird (Kull, 1984:52). Of those which can be placed into the "bird type" category, gulls and raptors (eagles, falcons, vultures, and owls) pose the greatest threat because of their size. As a comparison, in commercial aviation gulls take on a much larger percentage of all bird strikes.

Bird identification may not seem important to aircrews, but it actually helps the BASH team and others to make specific recommendations with respect to bird avoidance, bird control, or aircraft design.

The bird strike phenomenon is not just unique to the U.S. Air Force. The U.S. Navy has its share of similar problems, as does commercial aviation. Moreover, the problem extends itself around the globe. The following sections offer aircrews, schedulers, and others, pertinent suggestions relevant to the various phases of flight.

B. Scheduling/Route Planning/Bird Avoidance Model

(BAM)

As key decision makers determine when crews fly, schedulers, route planners, and operations officers all need a basic understanding of the bird strike problem. By understanding the problem, they can minimize the exposure of aircrews to the bird strike threat. Again, as with any decision making process, good judgment has to be used in this area. It is imperative that all staff officers, who deal with the scheduling of aircrews, coordinate with one another on this matter. Staff officers might include:

- Operations Officers
- Flight Schedulers
- Chief of Airfield Management (see Part IV)
- Supervisor of Flying/Last Chance
- Any route planners, especially those who plan

low-level missions.

-- Safety Officers (see Part V)

These staff officers must remember that the bird strike problem is not static. As mission requirements change, as weather patterns change, and as land use is altered, so do the flight paths of birds. Staff officers should be aware of the problem and be prepared for the unexpected.

Since birds are more active during early morning and late afternoon, it is recommended that low-level flying, takeoffs, and landings be restricted if bird strikes are being experienced at these times (Kull, 1984:50). In most situations, delaying departures or arrivals will be all that is necessary as far as the latter two cases are concerned. This delay will permit airfield management to use the appropriate bird control measures. With respect to low-level flying, it helps to know whether any special areas, such as wildlife refuges or nature preserves, are near the planned route which would attract large numbers of birds and cause problems. Many low-level routes are located in remote regions, which include areas of intense bird activity, especially during the migratory periods (Short, 1982:13). If routes are near such areas, re-routing will be necessary to insure aircrew safety. Assistance in this area can be obtained from the BASH team at Tyndall AFB, Florida or indirectly through the Chief of Airfield Management.

During peak periods of bird activity, such as during the migrations, several actions can minimize the bird strike risk.

-- Limit formation flying, particularly during takeoffs and landings

-- In May and October, the peak U.S. migratory periods, schedule more flights during the day, between the hours 0930 - 1530, since most birds are nocturnal migrants (Short, 1982:15)

-- If possible, avoid planning to fly low-level routes near bird attracting habitats

-- Fly low-level missions at slower airspeeds and/or higher altitudes. Remember, a majority of bird strikes occur at or below 500 feet AGL and over 90% at or below 3000 feet AGL

-- Raise traffic pattern altitudes, and if necessary restrict the number of touch-and-go's.

Bird Avoidance Model (BAM)

To help schedulers and flight planners select appropriate low-level routes, ranges, or military operating areas (MOA's), the BASH team developed a predictive bird avoidance model (for Continental U.S. only). This computer model can aid schedulers by predicting the relative bird strike risk for many of the several hundred low altitude military training routes. The model at present is based on 40 years of waterfowl

migratory data and, according to the BASH team, is about 70 - 75% effective in bird strike predictions (Kull, 1983:7). But, the effectiveness of the model for predicting bird strikes decreases to 50-60% when the model is compared to actual data for bird strikes involving all species of birds, not just waterfowl. A unique feature of BAM is that it permits updates as new information becomes available, such as information on new wildlife refuges, new training routes, or even on species not previously included in the model (Short, 1982:15). To improve the current data base of the model information on raptors will be incorporated, perhaps as soon as mid-1985 (Kull, 1983:7).

The model, as it is now, depicts graphic information for the period September to May, which spans the two migratory periods in the United States (BASH team, 1983:12). The graphs can display information one of two ways. One type shows the risk for a given route for day, dawn/dusk, and evening hours all on the same graph (see Figure 12). The other type maps the risks for several routes (up to 8) on one graph for one of the three time periods mentioned before (see Figures 13-15). The first case permits a scheduler to choose a low risk time period for a given route. The second case allows more flexibility in route selection.

When the graphs are used, several details should be

Kept in mind. First, the computer establishes convenient numbers along the Y-axis to create the graph. Second, the actual numbers themselves are not significant. However, when different routes are compared, note the relative magnitude of the numbers. For example, a route with a y-coordinate of 0.01 has a greater risk than one with 0.001. Thus, compare the graphs of different routes flown for the times of day needed. Keep in mind that the information provides a relative bird strike risk and that BAM is not yet sophisticated enough to predict actual bird strikes (Short, 1982:13).

Much of the time BAM will be used to predict the risk on published routes, but the model can also be used to evaluate proposed routes. If route information is submitted early during the conceptual phase, then the BASH team can evaluate the route segment by segment. Such an evaluation permits the planner to move routing as required, until an acceptable risk is found.

To obtain BAM information use the following simple guidelines (BASH team, 1983:13):

-- Published routes. Requests for graphs should include low-level route number, date and time of flight, and type of aircraft. Send this information to:

BASH Team
AFESC/DEVN
Tyndall AFB, FL 32403

-- MOA's, ranges, and proposed routes. Submit longitude and latitude of perimeter of MOA, range or turn points of proposed routes for an evaluation of these areas. Use the same address as above.

In order to justify further development of BAM, it is imperative that users advise the BASH team of the model's usefulness. Only when the data base is expanded, to include raptors, shore birds, and other birds, will the model be applicable all year.

C. Mission Planning

Proper mission planning is essential and should include the topic of bird avoidance. Transient crews must pay particular attention to this consideration, because many bird strikes occur away from home station (BASH team, 1983:13). Naturally, the nature of the mission, the aircraft being flown, and the location of the base(s) will determine the amount of bird-strike preparation needed. If new to a base, crewmembers should consult the squadron flying safety officer, operations officer, or a more experienced fellow squadron aircrew member for detailed information on local bird hazard procedures. The Wing Safety Officer and the Chief of Airfield Management can also provide necessary guidance in this area.

To help inform pilots and aircrews of the bird problem the Flight Information Publication (FLIP) and the

Airman's Information Manual (AIM) include general information on bird concentrations, hazards, and migratory routes. When looking up the subject matter in the general index, look under bird hazards, bird incidents, bird migration, or bird strikes. Because the format of FLIP changes from time to time, it is difficult to pinpoint the exact location of the data. In section AP/1 additional information can be found under the portion which addresses individual airfields, entitled "Supplementary Airport Remarks." Aircrews will find that bird hazards occur elsewhere in the world, and that the problem does not disappear when one leaves the United States. The European section of FLIP, for example, generally has devoted one chapter to bird hazard data/areas. If flying out of a commercial field, consult the Airport/Facility Directory (Harrison, 1984:10).

Several actions done during mission planning can minimize the possibility of a bird strike (Schultz, 1984:20):

- Plan what to do in case of a bird strike (i.e., table-fly the entire mission). Include the following topics in planning:

- Discuss low-level abort procedures and evasive actions (coordinate crew actions) (Porter, 1983:26)

- Discuss priorities for all crew members to include heading, altitude, and airspeed

- Review emergency procedures for takeoffs, landings, and low-level
- Discuss lost-communication procedures and change of aircraft control (Harrison, 1984:11)
- Discuss single and multi-engine failures
- Review egress procedures
- Brief the use of visors during the critical phases of flight where bird strikes occur (Schultz, 1984:17)
- Learn something about the present bird hazard environment.
- Plan to stay above 3000 feet AGL for as much of the flight as possible.
- (If flying low-level) Avoid overflight of national wildlife refuges or other wildlife sanctuaries. See sectional charts, if available.
- Avoid routes which follow rivers, shorelines or coastlines, particularly during spring and fall.
- Limit formation flying when bird activity is greatest.
- (For low-level missions) Increase altitude and reduce airspeed where possible, especially during high bird activity. For those who fly low-level missions on a regular basis, see the discussion of the bird avoidance model (BAM) in the previous section.

-- (In the traffic pattern) Plan to fly at a higher altitude. A change in altitude in the traffic pattern, of course, will have to be coordinated with the air traffic control personnel.

-- Look-out. An extra pair of eyes, if available, may make the difference between a strike and no strike.

Sections G and H will cover more information on what to expect if a strike occurs and actions to take.

D. Pre-Takeoff Briefing, Preflight, and Taxi

On the day of the flight:

-- Check current Notices to Airmen (NOTAMS) for any bird hazards (BASH team, 1984:15).

NOTAMS will generally list problems of short duration, such as bird concentrations, migrations, heavy feeding activity, or active control measures being employed. For problems of longer duration, see FLIP IFR-Enroute Supplement, if not already consulted during mission planning. Likewise, for long term bird hazard information, check FLIP AP-1 under "Supplementary Airport Remarks."

For bases that have initiated a 'Bird Watch' program:

-- Check the current Bird Watch status before flying (BASH team, 1984:14)

Bird Watch, which is similar to Metwatch for severe weather, notifies aircrews of operational changes brought

about by bird activity in the local area. For more detailed information about Bird Watch, if it applies to your base, see the wing Bird Aircraft Strike Hazard Plan as directed by AFR 127-15 (also known as the Base or Wing BASH Plan). A sample BASH plan is included in the appendix.

Because each base has its own unique bird problems, the Bird Watch conditions will be separately and uniquely defined and will differ from installation to installation. The Bird Watch conditions can quickly alert crews about bird activity and the need to "implement unit operational procedures." Sample Bird Watch conditions, taken from the MacDill AFB Bash Plan, reads as follows (BASH Plan, 1982:S-1):

-- Bird Watch Condition RED: Heavy concentrations above and immediately in the vicinity of the runway or at a specific location on Avon Park/low-level route pose an immediate hazard to safe flying operations. The area declared RED shall be open only by specific pilot request upon being advised of the condition.

-- Bird Watch Condition YELLOW: Concentrations of birds observed or predictable in locations which represent a probable hazard to safe flying operations. Declaration of condition YELLOW requires increased vigilance by all agencies and extreme

caution by aircrews.

-- Bird Watch Condition GREEN: Normal bird activity in the area. Upon extended normal bird activity, no bird watch condition need be declared.

If not covered during mission planning, REVIEW BIRD STRIKE EMERGENCY PROCEDURES. Crews should not treat this area lightly and should brief it like any other emergency procedure. For more specific items to cover, see the previous section. Some other items follow.

Several actions prior to takeoff can insure a safer takeoff and departure.

-- Where available, tune in the ATIS channel for last minute updates on possible bird hazards (Reznick, 1984:281).

-- While taxiing, be on the lookout for bird activity on the airfield.

-- When possible report bird sightings to the Supervisor of Flying (SOF), the Last Chance Vehicle, and Air Traffic Control (ATC) personnel. Request that the airport management disperse the birds before takeoff.

-- DO NOT take-off if flocks are in the runway environment (Harrison, 1984:11).

-- While waiting for takeoff, try to keep the birds in sight. This chore may not always be possible, so let the ATC personnel help as much as possible in

minimizing the bird strike threat.

E. Takeoff and Departure

As might be expected most bird strikes occur during takeoff and landing. Also at these times crews have the least time to watch out for birds. An engine loss on takeoff is most critical, so crews should know engine loss and crash landing procedures.

-- If an engine ingestion occurs on takeoff, abort if possible. Ground and maintenance crews should inspect the engine before another takeoff attempt is made (Harrison, 1984:11). Insure that the engine is inspected thoroughly, since undetected engine damage could cause more severe problems later on.

-- If the situation dictates that the takeoff must be continued, "properly identify the affected engine and execute appropriate emergency procedures (Harrison, 1984:11)."

-- Where possible, use a steeper climb gradient to get the aircraft above 3000 feet AGL quicker. If flocks of birds are encountered, a multiple bird strike or engine ingestion of many birds could occur.

-- Time permitting, initiate a climb, since most birds tend to dive when approached closely by an aircraft (Cooper, 1983:21).

Although not yet proven, there are indications that strobe lights do alert birds in time for them to avoid

aircraft. Thus, strobe lights should be used for takeoff and departure while below 10,000 feet AGL, where the majority of bird strikes occur. Strobe lights will also help other aircraft see and avoid each other. There is, however, more controversy as to whether landing lights deter birds. In some cases they may attract birds and even hypnotize them (Kull, 1984). A better recommendation is to use strobe lights if available and not to use landing lights unless required. If used together the flashing of the strobes should catch a bird's attention and alert it to oncoming aircraft.

F. Inflight - Cruise

Because a small percentage of bird strikes occurs during cruise (less than five percent) (Richardson, 1981:14), aircrews have little to worry about during this phase of flight. Bird strikes, however, have been reported as high as 33,000 feet MSL (Harrison, 1984:9). The high altitude strike will probably occur during the migratory periods of March to May and August to November. During the spring many birds will take advantage of southerly winds in migrating to the north. Northerly winds during the fall will aid the migration to the south. In both cases birds will move in larger numbers during clear, fair-weather nights. According to studies done in the Netherlands with radar, birds may fly higher over the ocean and other large bodies of water than over land.

(Buurma, 1984:145).

During the cruise portion of the flight, be on the lookout for flocks of migratory birds. As mentioned in the previous section,

- If encountering birds, initiate a climb to fly above the flock.
- Do not fly directly under flocks of migrating waterfowl, because birds tend to dive when approached (Cooper, 1983:21).

Moreover, notify the nearest FAA ARTCC, FSS, or tower if large flocks of birds are encountered. Advise these agencies of:

- Geographic location
- Bird species (if known)
- Approximate number
- Altitude
- Direction of bird flight path

6. What to Expect: Cockpit Penetration and Engine

Ingestion

Birds subject aircraft to two major risks, cockpit/windshield penetrations and engine ingestions, both of which can lead to major aircraft damage or even a fatality. Cockpit penetrations normally occur during takeoff/climbout or during high speed low-level runs (Harrison, 1984:9). A bird, at the speeds aircraft fly, becomes a high-speed projectile, whose impact

increases geometrically with the speed of the aircraft (Salmon, 1984:5). For those pilots who are flying single-engine reciprocating aircraft, it is worthwhile to note that a fast-moving propeller in front of the cockpit does not protect the crew from a cockpit/windshield penetration (Harrison, 1984:10).

If a cockpit/windshield penetration does occur, crews can expect wind blast, shattered glass, and plenty of feathers (Harrison, 1984:10). Crews will have little time to react, and the noise from the windblast will quickly make communications unintelligible. Depending on the size of the bird, feathers can obstruct a pilot's vision, and likewise make communications difficult. A crew can expect electrical failures which could cause overheating and eventually fire. Loss of pressure will create a cold cockpit environment, but if crews try to turn up aircraft heat, they could also cause overheating and create a fire hazard (Brown, 1982:11). At its worst, a bird strike can result in the loss of aircraft control.

Just a word about physical injury: almost any injury can occur, but a typical penetration would include facial lacerations, numerous cuts on the arms, legs, and hands, and possibly loss of vision (Harrison, 1984:10). Because pilots tend to cover their face just prior to impact, their arms and hands may receive more cuts. A large bird, such as a hawk, goose, or a swan, could easily tear a

portion or an entire arm off.

With an engine ingestion, the cockpit area is unaffected, but the damage could be just as serious (Harrison, 1984:10). Damage could range from a slightly nicked fan or compressor blade, to a flameout of the engine(s). In this situation crews can expect:

- increasing engine vibrations
- high exhaust gas temperatures
- compressor stalls
- engine fires
- catastrophic failure

H. Actions to Take

If either a cockpit penetration or an engine ingestion occurs, pilots will most likely have to treat the situation as an emergency. Depending on the nature of the event, crews should:

- FLY THE AIRCRAFT, collect their wits, and act quickly
- Check heading, altitude, and airspeed

Initially, mental awareness of the situation is a crew's best asset (Brown, 1982:11). When possible:

- Complete a controllability check at a safe altitude before landing
- Check emergency procedures in Section III of the Flight Manual

An important thing to remember is that, unknown to the

aircrew, a compound emergency may be at hand, and that a minor problem may cause a major one later on (McCartney, 1984:9). For example, a bird strike to the gear pod of an aircraft may have caused a hole in the fuselage as well as damaged hydraulic lines internally. This could cause the landing gear not to extend and/or loss of hydraulic fluid for other aircraft systems.

Although the nature of the emergency will dictate the actions to be taken, some specific suggestions are listed here (Harrison, 1984:11). If a cracked or delaminated windshield results, the first actions would be to slow the aircraft and wear sunglasses or goggles for eye protection should the windshield break. Naturally, a visor should be used when available. Sunglasses or goggles will also give some protection from wind blast, precipitation, or debris if a cockpit penetration happens at impact. In a high-speed situation:

-- initiate a climb to reduce airspeed and windblast and also to climb above the bird flock, if present.

Suggestions and recommendations for engine ingestion were discussed in Section E (Takeoff and Departure), because power loss on takeoff is most critical. As emphasized before, crews must properly recognize the emergency at hand and follow the appropriate engine-out or crash-landing emergency procedures (Harrison, 1984:10).

I. Approach and Landing

Many of the comments made for the takeoff and departure (Section E) apply equally well for the approach and landing portion of the flight. Having been at a higher altitude (above 3000 feet AGL), the aircraft has gone from the area of minimum to maximum bird threat. If available,

-- Check ATIS for latest Bird Advisories (Rezick, 1984:28)

-- During descent use strobes and landing lights if required (see previous discussion on lights in Section E)

Landing lights may help pilots to determine if they are flying through a flock of birds, especially during low visibility and night conditions (Harrison, 1984:11).

If it is necessary to descend into a high concentration of birds, approach speeds should be adjusted as necessary. The slower the airspeed the less impact force will result if a bird is struck. Slowing airspeed not only reduces impact potential but also gives aircrews a better chance to see and avoid. At speeds below 250 KIAS the chances of seeing birds increase and naturally so do the opportunities to take evasive action (Schultz, 1984:16).

Another technique, if high bird densities are known to be present, is to use a steeper than normal approach

angle (Solman, 1984:5). With this method, less time is spent in the critical altitudes where birds might be flying. If birds are encountered during descent or while on an instrument approach, consider executing a missed approach (Harrison, 1984:11). By the time the aircraft returns to the airfield the birds may have moved on.

-- DO NOT LAND if flocks are present on the runway or in the vicinity of the approach end of the runway.

J. Traffic Pattern

Since much of an aircrew's pattern work could be flown at altitudes of less than 3000 feet AGL, emphasis must be placed on "see and avoid" (Schultz, 1984:16). Where possible, use a spotter in the jump seat. If flocks of birds are spotted, notify tower, and try to keep the flocks in sight. Birds are much easier to locate at airspeeds below 250 KIAS, and lower airspeeds give pilots more time to react. If birds are flying through the traffic pattern area:

-- A higher pattern altitude should be flown

-- (If birds congregate in the runway environment)

Do not hesitate to go-around/execute a missed-approach.

-- Coordinate with tower/SOF to request bird dispersal units.

K. Postflight

After landing, if a bird strike is suspected, the

aircraft should be checked for any possible damage.

- Give the maintenance personnel a full description of the event
- Complete the required forms discussed in the next section

If any bird remains are discovered, a small sample with feathers should be collected. Although maintenance personnel can do the task just as well, it would be better for crew members to pick the feathers up before they are washed or blown away. These remains should be taken to the Wing Safety Officer, who in turn will send them to local authorities or the BASH team for identification (Kull, 1984).

L. Reporting Procedures

Regardless of the amount of damage done, it is important that ALL bird strikes be reported to Wing Safety in accordance with,

- AFR 127-15 The Bird Strike Hazard Reduction Program.

For Class C mishaps or higher, the bird strike must be reported in accordance with:

- AFR 127-4 Investigating and Reporting U.S. Air Force Mishaps

Although the Air Force Inspection and Safety Center at Norton AFB, CA., does not require or want reports on non-damaging bird strikes (class C - less than \$1000

damage), the BASH Team needs data on ALL strikes to maintain and improve their Bird Hazard Reduction Program. Only then can they provide effective support for flying organizations. Full reporting details are listed under "Reporting Bird Strikes" in Chapter Five of AFR 127-4 and under "Base Bird Strike Reporting" in AFR 127-15.

M. Bird Strike Avoidance Training

One of the many duties of the Squadron Flying Safety Officer (FSO) is to insure that aircrews are informed and briefed about the Air Force BASH reduction program with emphasis on prompt reporting of all bird strikes (BASH Plan, 1982:B-3). Since the BASH problem varies considerably from base to base, the FSO must use good judgment in selecting the materials he/she briefs during flying safety meetings and items he/she posts on the squadron flying safety bulletin board. The Wing Safety Officer can offer guidance in this area. The important thing is for crews to develop an awareness of the bird strike hazard.

As a minimum crews should be briefed on the general bird hazard, the Air Force BASH Reduction Program, to include AFR 127-4 and AFR 127-15, bird strike reporting procedures and basic bird strike avoidance procedures. The best plan is to devote half or even an entire flying safety meeting to the bird problem. These meetings could be held three or four times a year, depending on the

nature of the local threat. Since bird activity may occur at different times of the year for each base:

- Recommend that BASH oriented flying safety meetings be held prior to periods of intense bird activity
- Remember that a base may experience a bird hazard unexpectedly, which could last for several days or weeks; and that crews will fly to other bases which may have bird hazard problems.

For bases that do not have a serious problem, recommend that the BASH topic be discussed periodically in more general terms.

For bases that experience frequent bird activity, more time should be devoted to bird strike avoidance training. Naturally, detailed techniques and procedures to follow if a bird strike occurs should be covered. A follow-up mission in the simulator would be highly recommended. This handbook has provided some of that information. A careful examination of bird strike procedures will enhance a crew's ability to react quickly and sensibly to what is often a sudden, unexpected event.

Additional items to discuss at flying safety meetings would include:

- Base's local BASH plan
- Specific local bird hazards (species)
- Bird avoidance model (BAM) use

-- METWATCH and how it is used
-- Bird strike reports and individual accounts of past bird strikes. Many articles can be found in the numerous safety publications such as Combat Crew, TAC Attack, MAC Flyer, and Flying Safety.

Although much has been written about bird strikes, few movies or sound/slide programs have been made. Moreover, of those productions, fewer yet deal with the bird hazard from the aircrew point of view. A most recent film, entitled Dangerous Encounter, examines bird strikes from a pilot point of view. Produced in part by the BASH team, the movie should be available for release in late 1984. Other bird strike audio-visual productions are listed at the end of Part IV. (Airfield Management).

N. Bird Strike Statistics (1983 and 1980-82)

-- 1983 (Kull, 1984:50,57)

Figure 1 - Bird Strikes by Time of Day

Figure 2 - Bird Strikes by Phase of Flight

Figure 3 - Bird Strikes by Altitude

Figure 4 - Bird Strikes by Aircraft Type

Figure 5 - Monthly Bird Strikes

-- 1983 (Kull, 1984:50,57)

Table I - Bird Strikes by Impact Point (On Aircraft)

Table II - Birds Involved in Bird/Aircraft Strikes

Table III - Bird Strikes by Aircraft (1980-82)

-- 1980-82 (Kull, 1983:5-7)

Figure 6 - Bird Strikes by Time of Day

Figure 7 - Bird Strikes by Phase of Flight

Figure 8 - Bird Strikes by Altitude

Figure 9 - Bird Strikes by Aircraft Group

Figure 10 - Average Monthly Bird Strikes

Figure 11 - Average Monthly Bird Strikes

(Day vs. Night)

Figure 12 - Bird Avoidance Model

(Day/Dawn, Dusk/Evening)

Figure 13 - Bird Avoidance Model (Dawn/Dusk)

Figure 14 - Bird Avoidance Model (Day)

Figure 15 - Bird Avoidance Model (Night)

Bird Strikes by Time of Day

1983

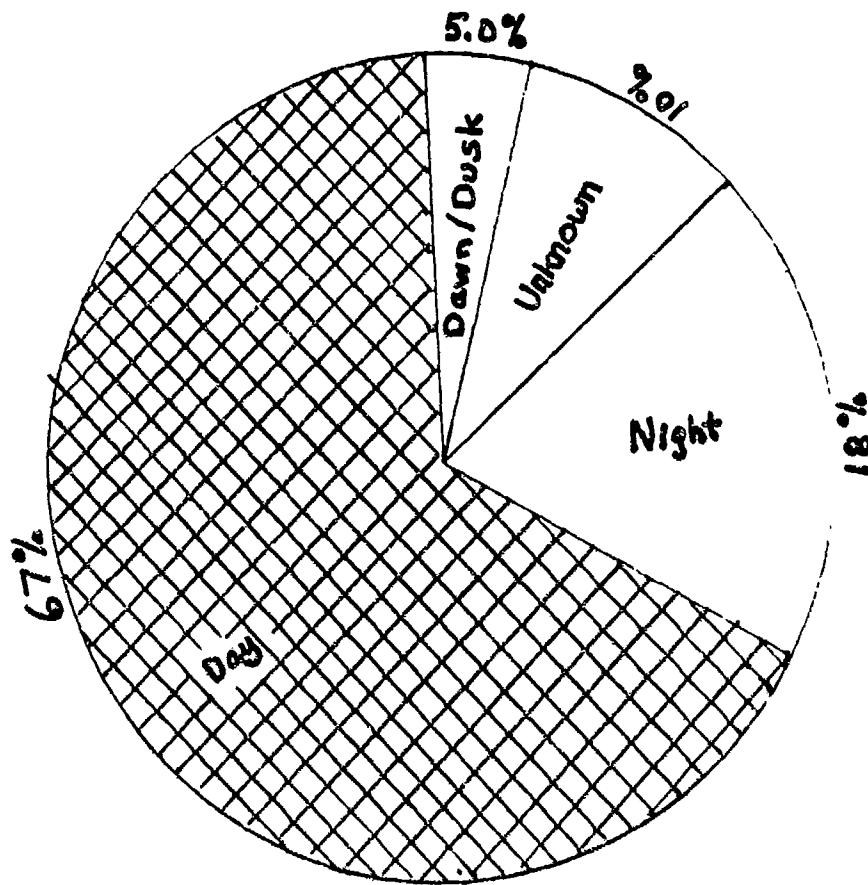


Fig. 1. Bird Strikes by Time of Day (1983)

BIRD STRIKES BY PHASE OF FLIGHT

1983

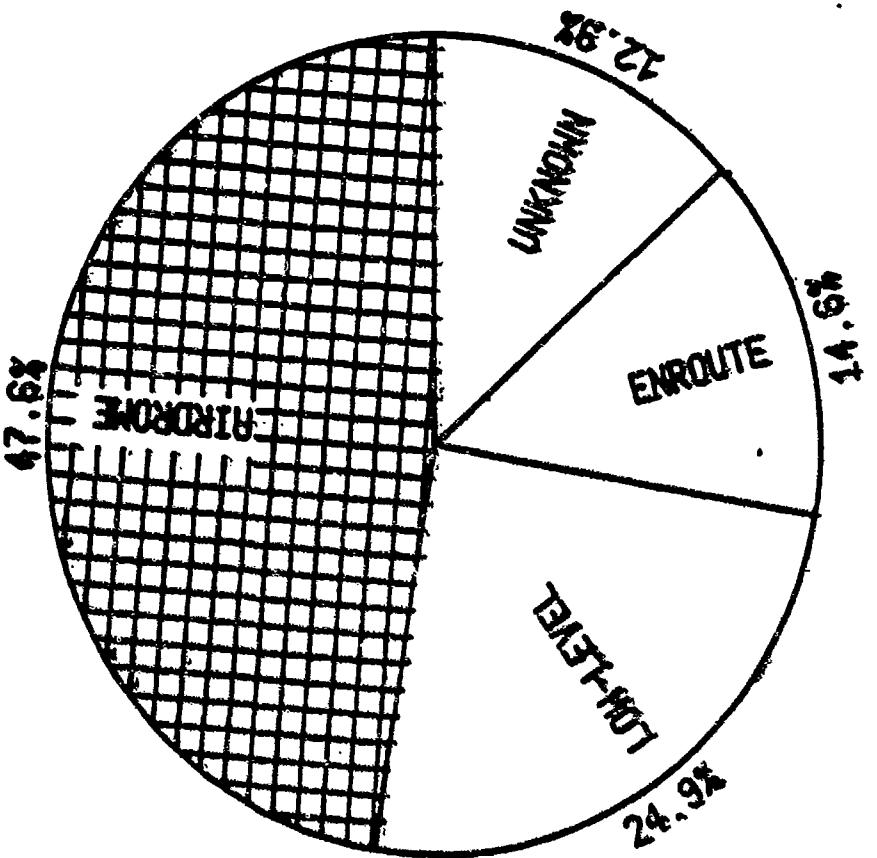
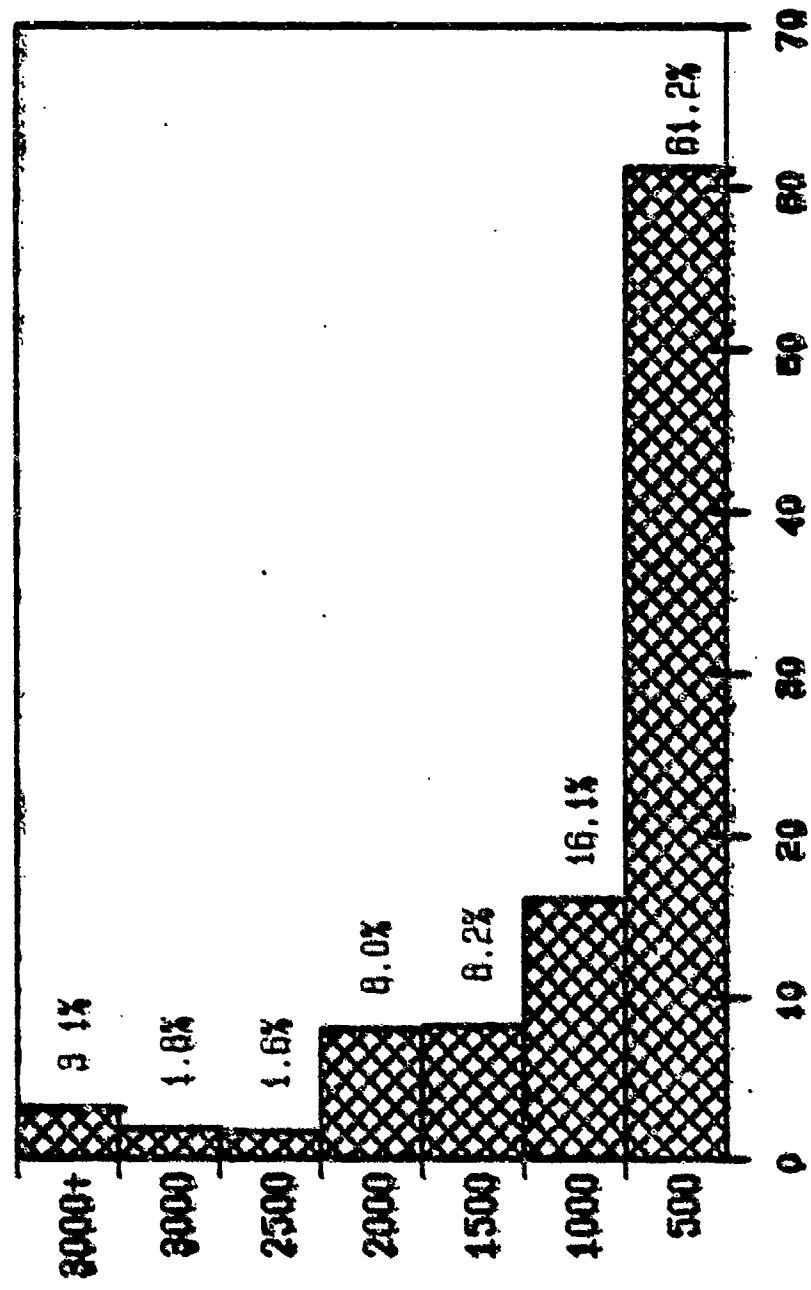


Fig. 2. Bird Strikes by Phase of Flight (1983)

BIRD STRIKES BY ALTITUDE

1983



Percentage of Strikes

FIG. 3. Bird Strikes by Altitude (1983)

BIRD STRIKES BY AIRCRAFT GROUP
(1983)

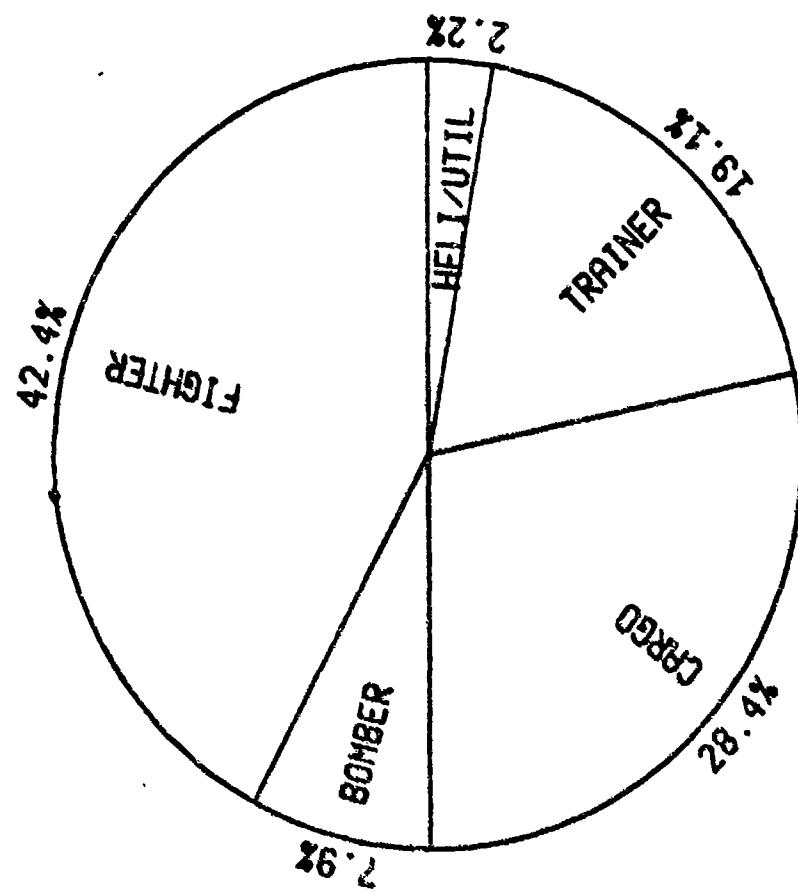


FIG. 4. Bird Strikes by Aircraft Group (1983)

MONTHLY BIRD STRIKES

Day vs Night
1983

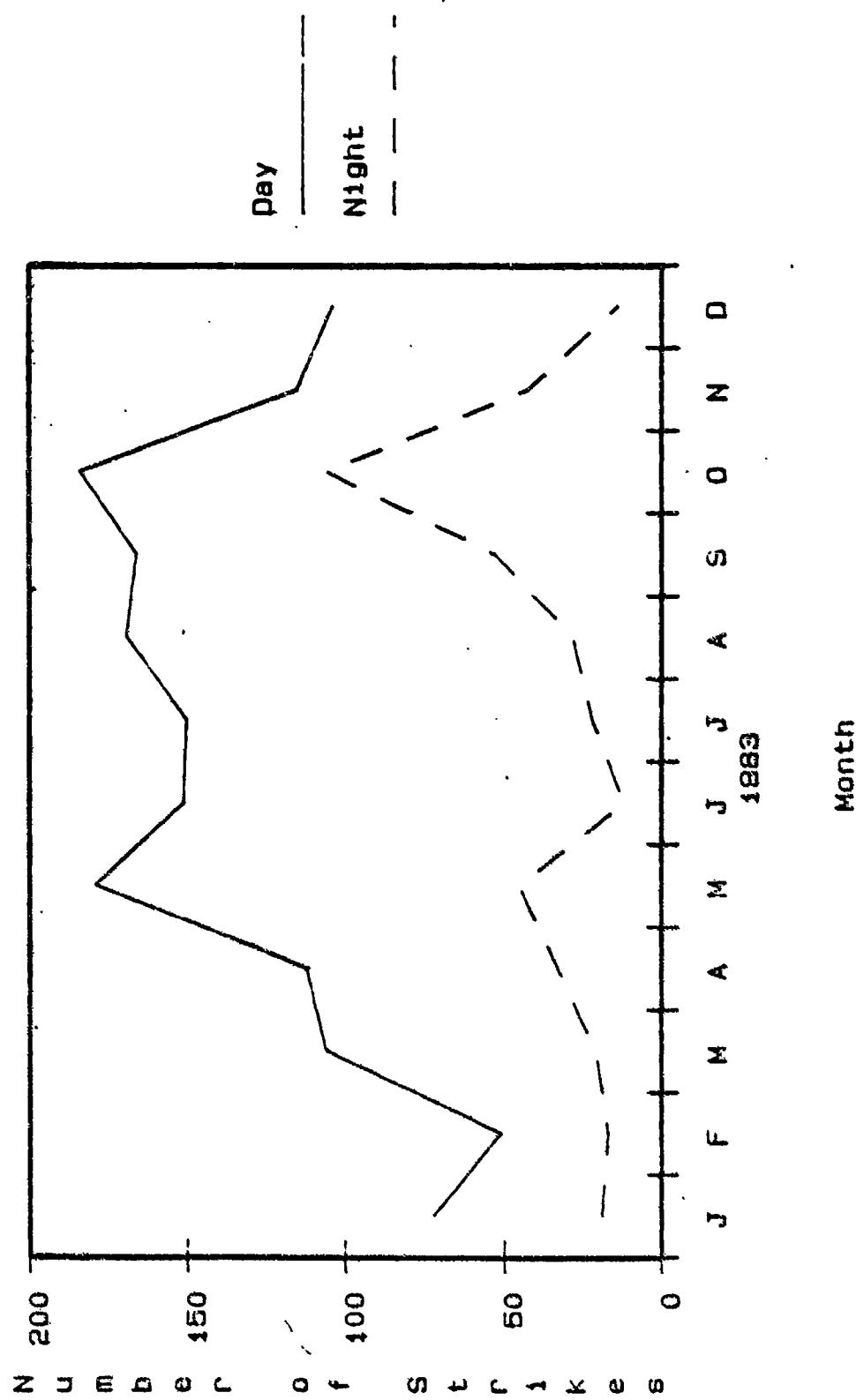


Fig. 5. Monthly Bird Strikes (1983)

Table I
Bird Strikes By Impact Point

<u>IMPACT POINT</u>	<u>PERCENT</u>
Engine/Engine Cowling	22.3
Windshield/Canopy	20.6
Wings	19.3
Radome/Nose	15.1
Fuselage	8.9
External tanks/pods/gear	6.7
Multiple hits	5.2
Other	1.9

Table II
Birds Involved in Bird/Aircraft Strikes

<u>BIRD TYPE</u>	<u>NUMBER OF STRIKES</u>
Starlings	39
Shorebirds	17
Blackbirds	22
Horned Larks	27
Meadow Larks	29
Doves	41
Pigeons	19
Gulls	122
Egrets and Herons	21
Vultures	46
Hawks, Falcons, and Eagles	126
Ducks	52
Geese	10

UNIDENTIFIED BIRDS

Small Birds	406
Medium Birds	38
Large Birds	50

TABLE III
Bird Strikes by Aircraft
(1980-1982)

Aircraft	No. Bird Strikes	No. Flight Hours	Bird Strike Rate (per 1000,000 hrs)
A-7	75	256,603	29.2
A-10	501	523,274	95.7
A-37	17	77,967	21.8
B-52	353	385,928	91.5
B-57	1	9,683	10.3
C-5	71	156,960	45.2
C-9	70	83,815	83.5
C-12	4	16,536	24.2
C-123	0	34,907	0.0
C-130	266	1,095,888	24.3
C-135	349	775,082	45.0
C-141	170	854,570	19.9
E-3	15	66,884	22.4
E-4	6	6,161	97.4
T-39	34	243,931	13.9
T-43	17	52,530	32.4
F-4	635	1,046,011	60.7
F-5	15	91,665	16.4
F-15	132	390,547	33.8
F-16	117	188,979	61.9
F-101	13	31,563	41.2
F-104	17	21,540	78.9

TABLE III (Cont.)

Aircraft	No. Bird Strikes	No. Flight Hours	Bird Strike Rate (per 1000,000 hrs)
F-105	13	57,908	22.4
F-106	19	181,139	10.5
FB-111	183	280,117	65.3
Helo	47	252,895	18.6
T-33	14	159,661	8.8
T-37	265	897,344	29.5
T-38	394	1,039,945	37.9
O-2	9	149,554	6.0
OV-10	48	92,076	52.1
TOTAL	3,988	9,521,663	41.9

Bird Strikes by Time of Day

1980-1982

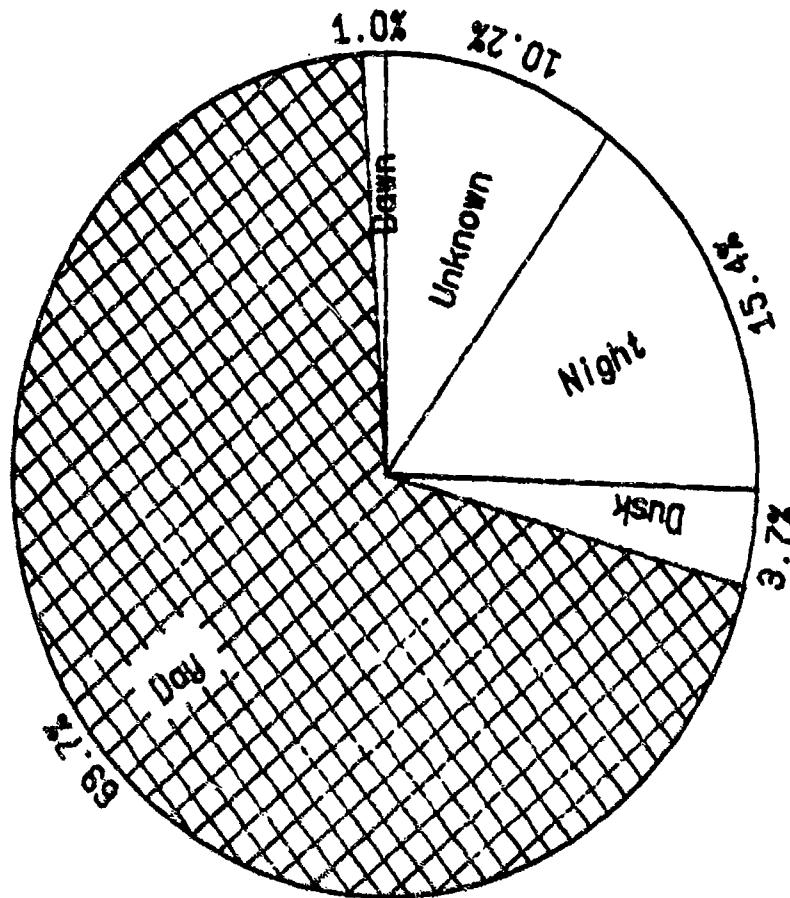


Fig. 6. Bird Strikes by Time of Day (1980-82)

Bird Strikes by Phase of Flight

Major Categories for 1980-1982

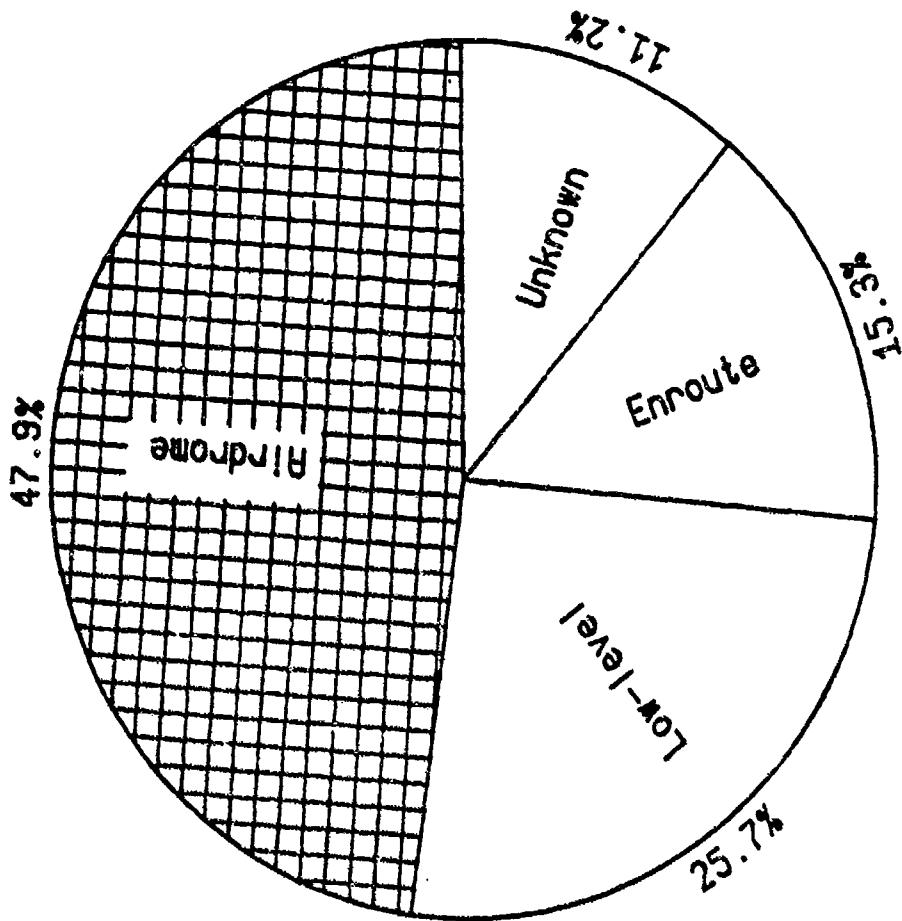
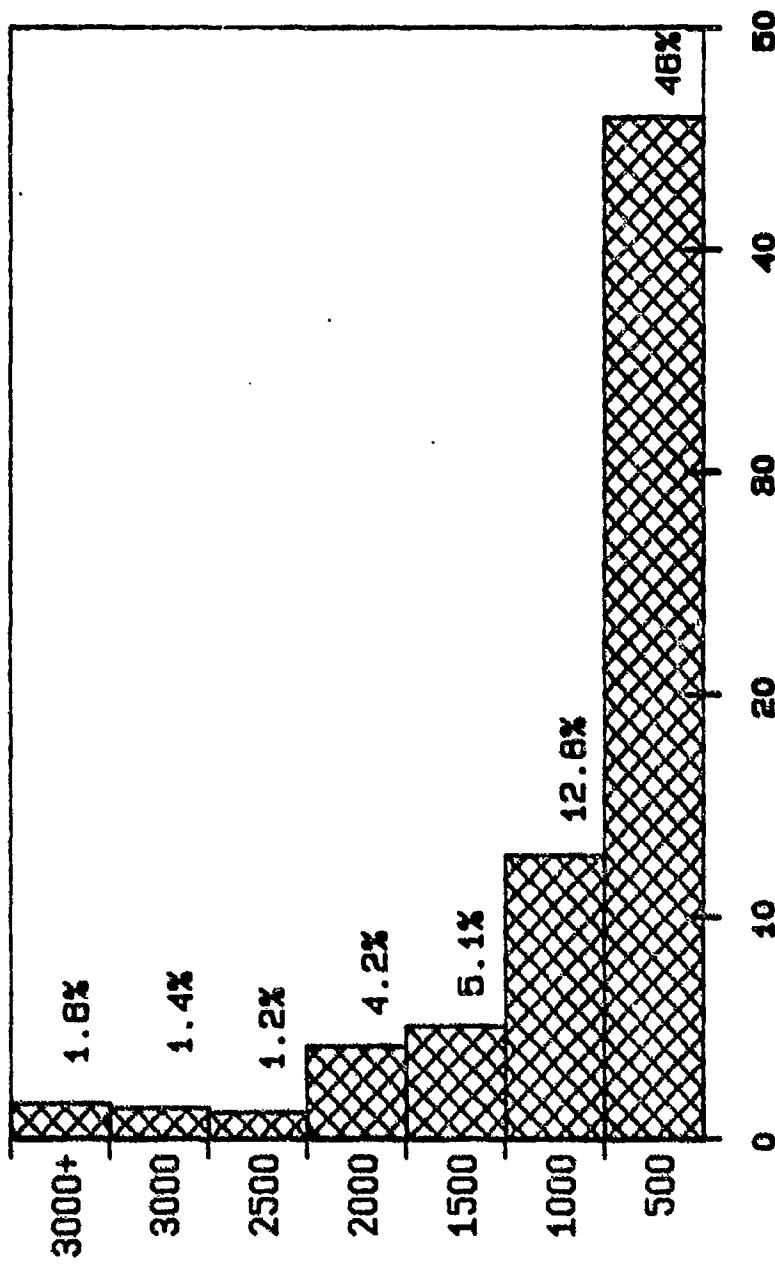


FIG. 7. Bird Strikes by Phase of Flight (1980-82)

Bird Strikes by Altitude

1980-1982



Percentage of Strikes

FIG. 8 Bird Strikes by Altitude (1980-82)

Bird Strikes by Aircraft Group

1980-1982

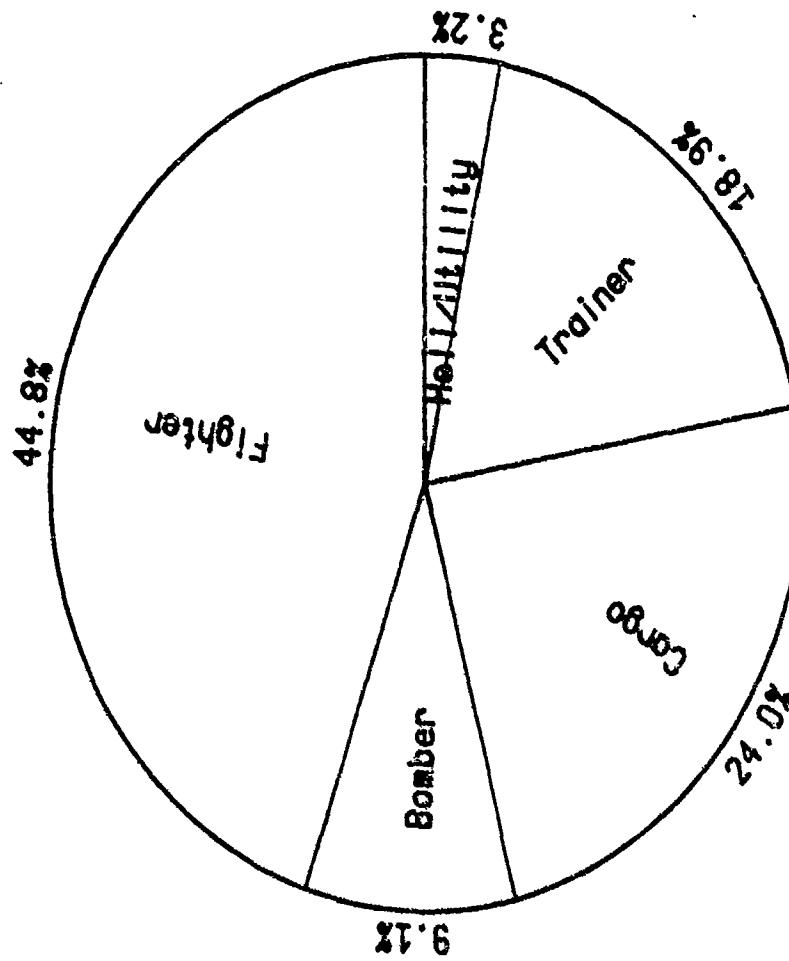


FIG. 9. Bird Strikes by Aircraft Group (1980-82)

Average Monthly Bird Strikes

1980-1982

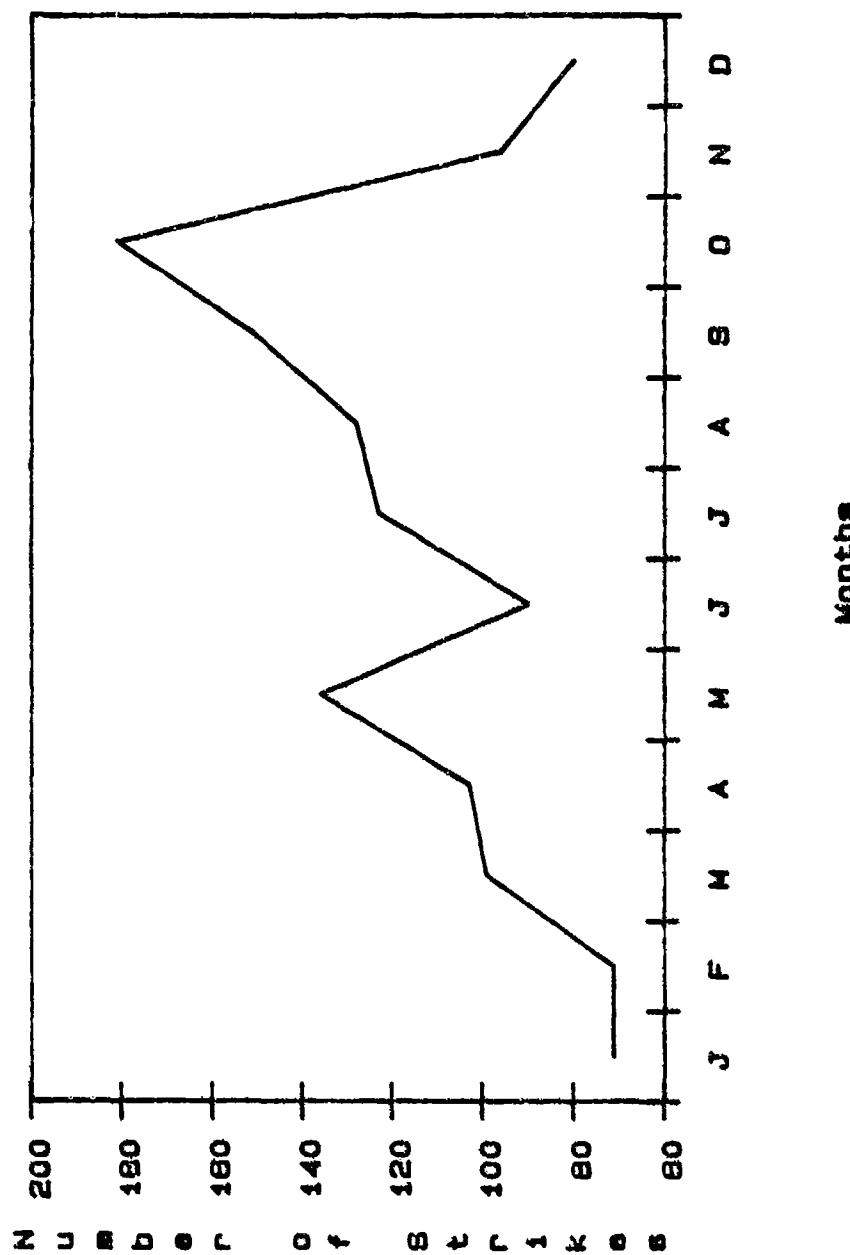


Fig. 10. Average Monthly Bird Strikes (1980-82)

Average Monthly Bird Strikes

Day vs Night

1980-1982

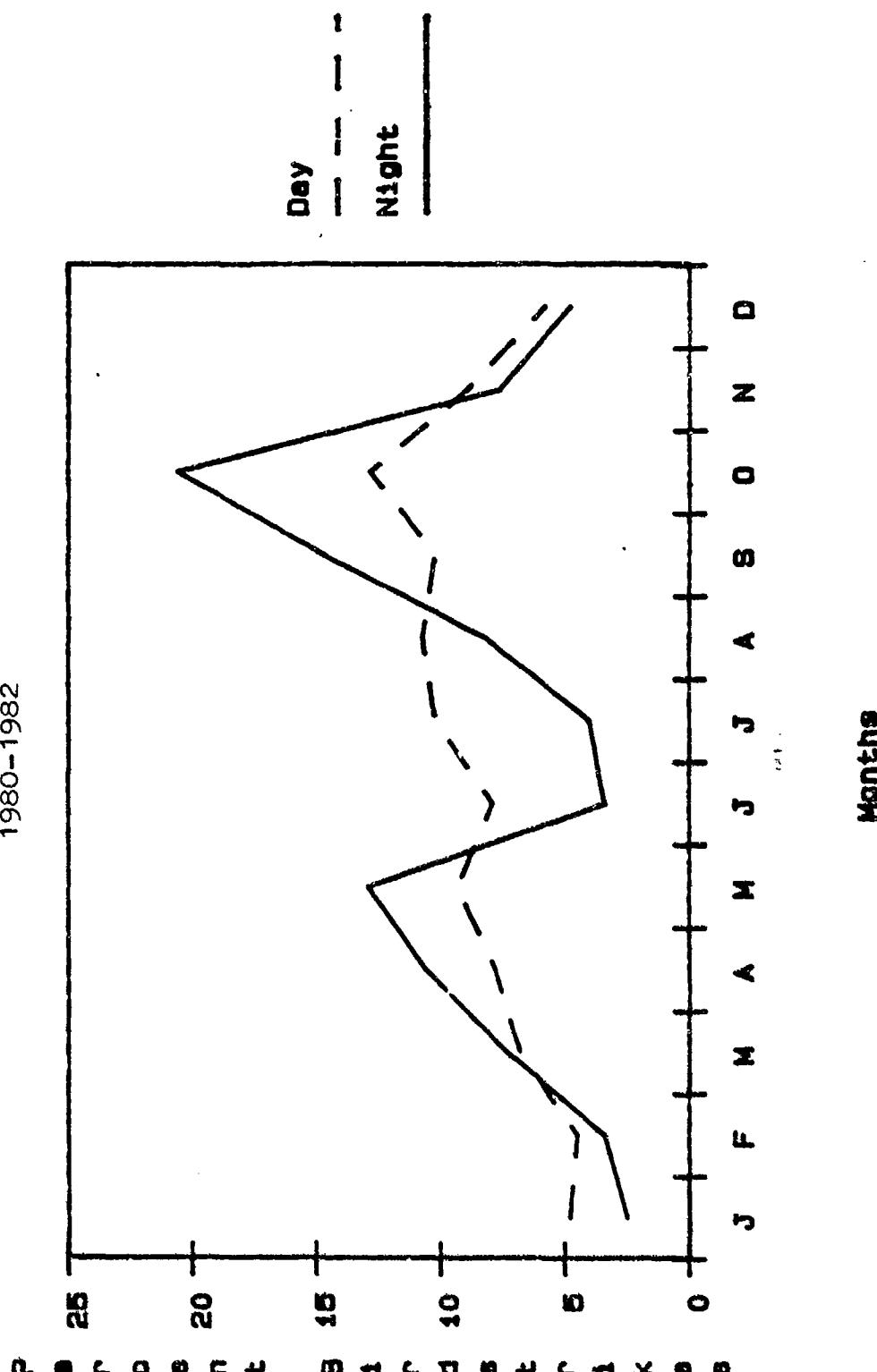


Fig. 11. Average Monthly Bird Strikes (1980-82) (Day vs. Night)

BIRD AVOIDANCE MODEL

Day/Dawn, Dusk/Evening

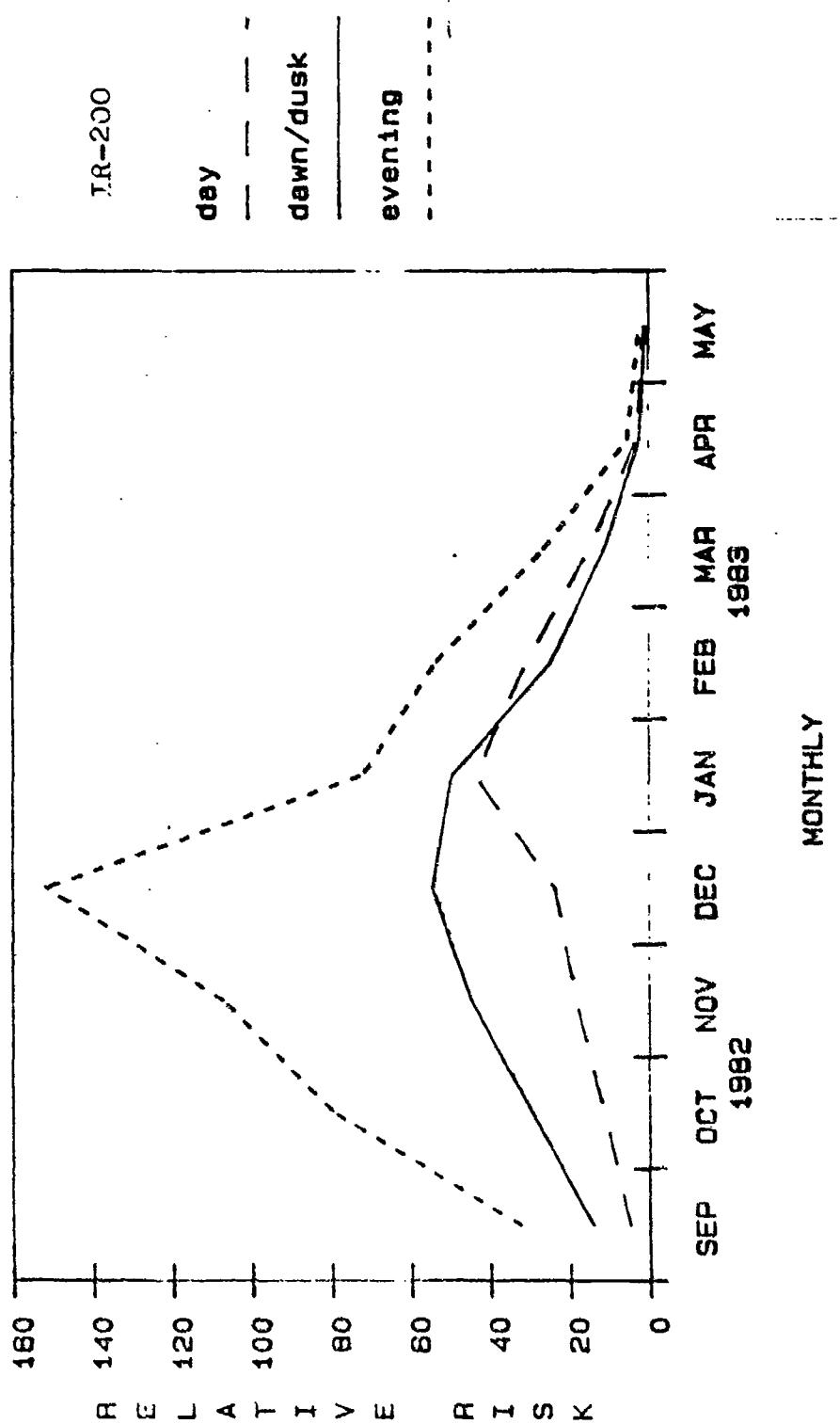


Fig. 12. Bird Avoidance Model (Day/Dawn, Dusk/Evening)

BIRD AVOIDANCE MODEL

Dawn/Dusk

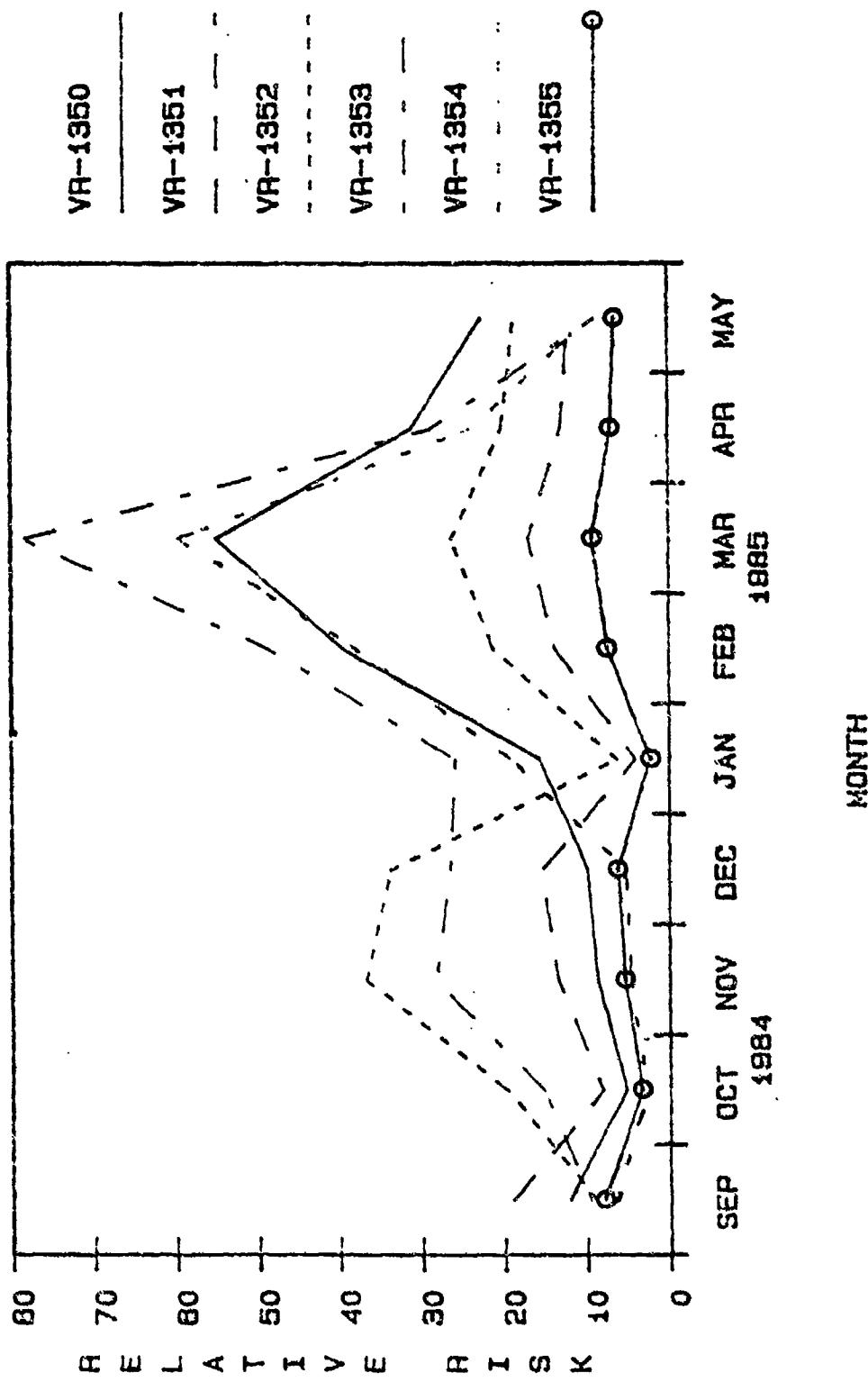


Fig. 13. Bird Avoidance Model (Dawn/Dusk)

BIRD AVOIDANCE MODEL

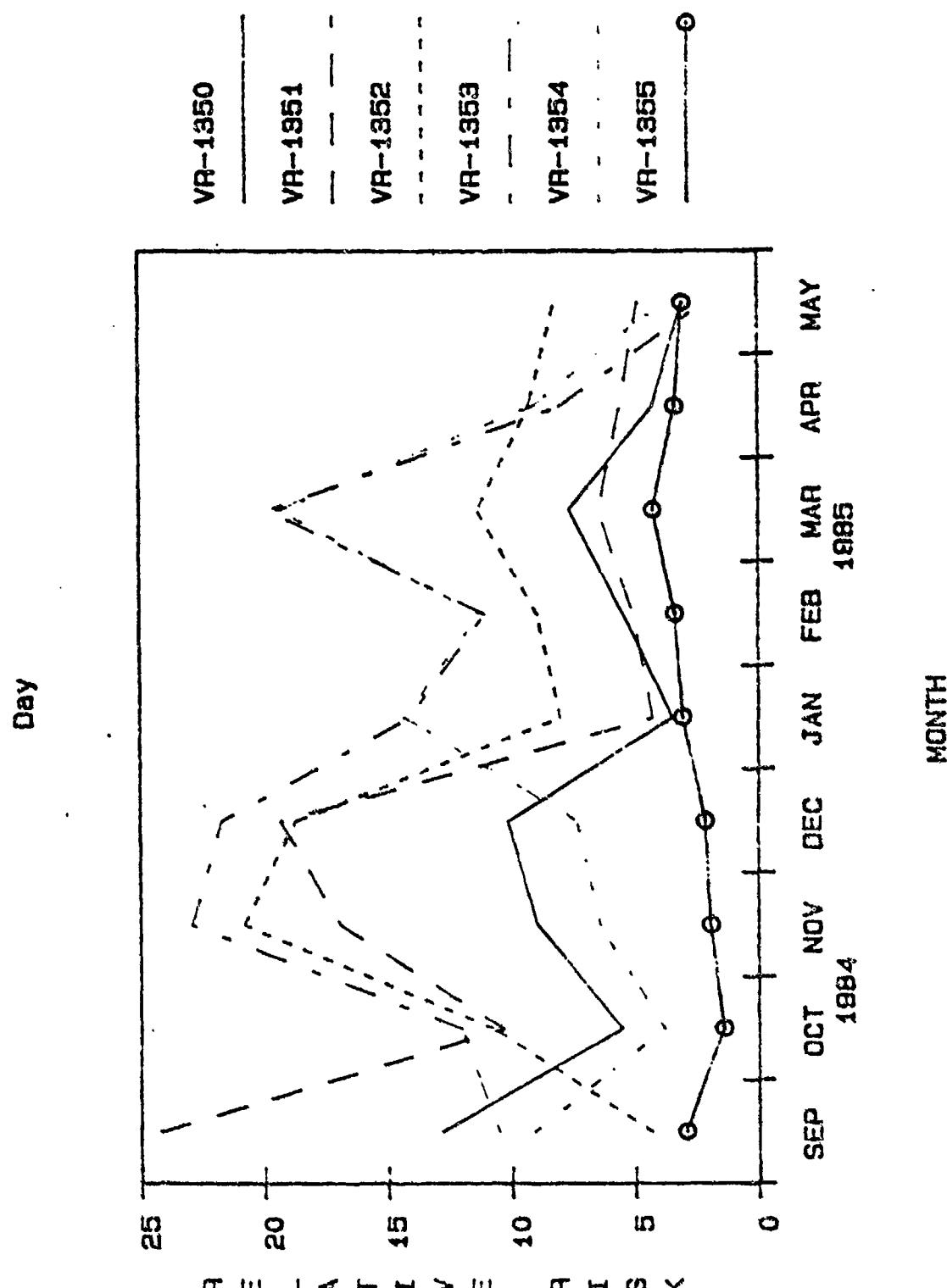


Fig. 14. Bird Avoidance Model (Day)

BIRD AVOIDANCE MODEL

Night

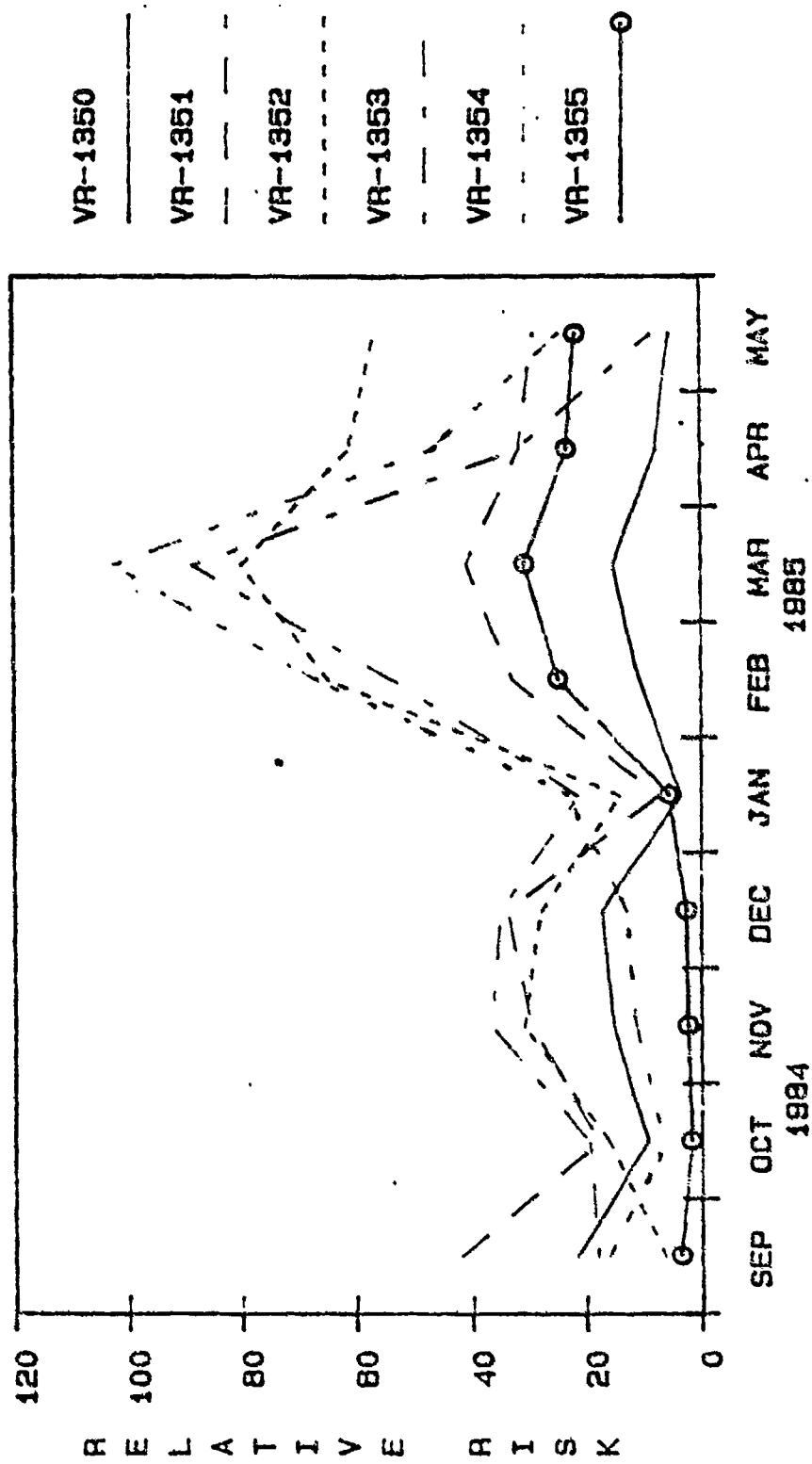


Fig. 15 Bird Avoidance Model (Night)

Bibliography

Bird Aircraft Strike Hazard Team (BASH Team). Bird Aircraft Strike Hazard (BASH) Guidance Package. HQ Air Force Engineering and Services Center, Tyndall AFB FL, 1983.

Brown, Captain Thomas D. Jr. "It'll Never Happen To Me," Combat Crew, 32: 10-11 (August 1982).

Buurma, Luit S. "On the Altitudinal Distribution of Birds and Bird Strikes in the Netherlands," Proceedings: Wildlife Hazards to Aircraft - Conference and Training Workshop. 133-147. National Technical Information Service, Springfield VA, 1984.

Cooper, Captain Rhett T. "Potential Flight Hazards- You Can Make The Difference," Combat Crew, 33: 20-21 (January 1983).

Department of the Air Force. Bird Aircraft Strike Hazard Plan. 56 TTW Plan 127-15. MacDill AFB: 56th Tactical Training Wing, 30 September 1982.

Harrison, Michael J. "Avoiding Serious Bird Strike Incidents," Proceedings: Wildlife Hazards to Aircraft - Conference and Training Workshop. 9-12. National Technical Information Service, Springfield VA, 1984.

Kull, Captain Robert C. Jr. "1983 Air Force Bird Strikes," Proceedings: Wildlife Hazards to Aircraft - Conference and Training Workshop. 49-57. National Technical Information Service, Springfield VA, 1984.

Kull, Captain Robert C. Jr. "Air Force Bird Strike Report," U.S.A.F. Safety Journal, 1(3): 4-7 (July 1983).

Kull, Captain Robert C. Jr. "Something New For Bird Strikes," Flying Safety, 39: 6-8 (June 1983).

Kull, Captain Robert C. Jr. Telephone interview. Bird Aircraft Strike Hazard Team, HQ AFESC/DEUN, Tyndall AFB FL, 12 July 1984.

Long, Major Geral L., Chief, Bird/Aircraft Strike Hazard (BASH) Team. Personal interview.
Tyndall AFB FL, 16 January 1984.

Macartney, Squadron Leader Mike. "Bird Strike - How Serious," Combat Crew, 34: 9 (March 1984).

Parker, Captain Jeff. "How to 'Duck' the Uninvited Arrival of a 'Foul' Friend," Combat Crew, 33: 26 (February 1983).

Reznick, Kaye. "Development of Bird Hazard Reduction For Airport Operational Safety," Proceedings: Wildlife Hazards to Aircraft - Conference and Training Workshop. 275-282. National Technical Information Service, Springfield VA, 1984.

Richardson, Major John E. "Birdstrike Report," Flying Safety, 37: 14-16 (September 1981).

Short, Captain Jeffrey J. "Bird Avoidance Model," Flying Safety, 38: 12-15 (June 1982).

Shultz, Harvey A. "Don't Fowl Out," Proceedings: Wildlife Hazards to Aircraft - Conference and Training Workshop. 13-23. National Technical Information Service, Springfield VA, 1984.

Soliman, Victor E. F. "Birds and Aviation," Proceedings: Wildlife Hazards to Aircraft - Conference and Training Workshop. 1-5. National Technical Information Service, Springfield VA, 1984.

Part IV. AIRFIELD MANAGEMENT

Because almost 50% of all bird strikes occur within 10nm of airports (Long, 1984), airfield management plays a key role in minimizing the bird hazard. The Chief of Airfield Management can insure success in this area by:

- Being represented on the Bird Hazard Working Group (BHWG)
- Conducting daily airfield inspections and keeping accurate records
- Maintaining an active bird control/dispersal program
- Helping generate an interest and awareness of the overall bird strike phenomenon.

To aid the Chief of Airfield Management, this section contains guidance for a sound airfield management/bird control program. The nature of the problem however will demand that the Chief of Airfield Management work closely with the Base Civil Engineer on many of the aspects of bird control. Likewise, he must coordinate with Air Traffic Control personnel on tracking and recording bird activity he would otherwise miss.

Contents

- A. Background/General Information**
- B. Daily Airfield Inspections/Record Keeping**

C. Bird Control/Dispersal Program
D. General Awareness and Education

A. Background/General Information

Much background information, including statistical data, is included in Part III entitled "Operations." The most important points to remember are:

- Almost 50% of all bird strikes occur within 10nm of airfields (Long, 1984)
- Over 90% of all strikes occur below 3000 feet AGL with most of those below 500 feet AGL (Kull, 1984:56)
- Daytime strikes make up 67% of all bird strikes and nighttime strikes account for 18% (Kull, 1984:50)
- Busiest periods for bird activity are morning and evening hours.
- Bird strikes, depending on base location, tend to increase during spring and fall migrations, with much of the migratory activity taking place at night.
- Fighter aircraft experience the most bird strikes.

Airfield managers, themselves former aircrew members, need to recognize the importance of the bird hazard and its overall place in the safety spectrum. This can best be done by becoming an active member of the base BHWG,

which has been described at the beginning of this handbook. Moreover, airfield managers should become familiar with the base BASH Plan, also described in the handbook introduction.

The bird strike hazard may arise unexpectedly any time of the year. Weather patterns, for example, can alter an entire migratory flight path and cause a sudden arrival of a species in the airport vicinity. Perhaps more insidious and easily overlooked, changes in land use nearby can attract and/or alter bird feeding, roosting, and other habits, such that unexpectedly one day a flock of birds shows up at the base. These events mean that short-notice actions will have to be taken and that airfield managers will have to be prepared ahead of time.

If the BASH Plan is designed well, part of the solution to any bird problem will already be spelled out, giving airfield managers several courses of action to initially guide them. A call to the BASH Team or local authorities can provide additional guidance. A call to airfield managers of other bases can offer more possible solutions to situations which may have already arisen elsewhere. Two key actions, however, can help reduce the potential "unexpectedness" of a bird hazard. Good airfield inspection records can help establish local bird behavioral trends, and because the annual migrations happen cyclically, bird movements become predictable.

B. Daily Airfield Inspections/Record Keeping

An important task of airfield management is to develop an ability to detect potential bird hazards. Because one person alone cannot accomplish this task, it is recommended that two courses of action be taken:

-- **Daily airfield inspections:** Not only to check the physical condition of the airfield environment, but also to check the biological environment as well.

-- **Good record keeping system:** To benefit from the daily inspections above, a good record keeping system must be developed, so that behavioral trends can be established and certain predictions made.

Quite obviously most airfield managers are not biologists nor do they have a biology academic background. Consequently, changes may occur at an airfield which will go by unnoticed and which might create a potential bird hazard. With a little guidance most managers can teach themselves what to look for. Moreover, assistance can be obtained from the BASH Team at Tyndall AFB, Florida, from local wildlife authorities and from the numerous publications available.

As has been mentioned before, three things attract birds to airfields: food, shelter, and water (Solman, 1984:2). With this in mind, a manager can learn how to identify or recognize the common bird species in the airport vicinity. Some species are permanent residents,

some are summer breeders, while others are wintering visitors. In no way, however, would one be able to identify all migrating species, particularly during the fall. As an aid to general bird identification, it is recommended that one of the popular field guides be obtained, as well as a pair of binoculars. Most book stores carry the current edition of the popular guides in stock, either as cloth-bound or as a good-quality paperback. The latter item can be obtained from the Table of Allowances (TA):

(Binoculars, prism, with NSN 6650-00-108-6629 and PN6702513).

What is one looking for on an inspection? The best answer is anything that can attract or is attracting birds to the airfield environment:

- Infestation of insects
- Increase in small rodent population
- Carrion
- Increase in standing water
- Change in the local ecology to include the cutting of trees, mowing of grass, or tilling of land
- Sanitary landfill effects
- Seeds from grasses near the runway

In addition to noting the attractants above, one should also note behavioral activity of the birds (BASH, 1983:3), such as:

- feeding
- roosting
- loafing
- soaring
- drinking
- flying regularly across the airfield

Further, a good observer will also note the species, date, time, weather conditions, and airfield location. Because a single, daily inspection would miss much of the bird activity throughout the day, it is important to enlist help from other organizations who have personnel that frequent the flight line/runway area. Any unusual sightings may help determine a potential problem later on. Air Traffic Control personnel can also provide extra eyes, especially during their slack periods.

Because birds fly easily from one location to another, airfield managers should get to know the entire airfield environment, and become familiar with the land surrounding the base, out to five or ten miles. This distance will vary from base to base depending upon the local geography of the land. Again, anything that attracts birds and might bring them to the base area should be considered a hazard. Coordination with local authorities will be necessary in solving problems outside the base perimeter.

"Bird watching" obviously cannot be a full-time task

of airfield management, hence, the need for accurate records for observations taken. On some occasions managers may want to increase their observations, especially during the migratory season and other periods of intense bird activity. As suggested by the BASH Guidance Package, a copy of which can be obtained from the BASH Team, photographs may help identify potential problems (BASH, 1983:4). Most managers will have to design their own techniques and methods of bird observation and record keeping to fix their own needs. As an example of a daily airport inspection report, see figures 1, 2, and 3 (Port of Portland samples) at the end of this report on Airfield Management.

C. Bird Control/Dispersal Program

When a bird hazard is identified, whether it be gulls on the runway, roosting cattle egrets on the airfield, or transient flocks of blackbirds, two courses of action can be followed. The preferred method, a passive control, offers a long-term solution, usually through habitat modification (Reznick, 1984:275). This course of action becomes the responsibility of the Base Civil Engineer and is covered in Part II. The second method, an active control, tries to disperse birds as quickly as possible from the threat area. Short-term in nature, this approach usually involves only airfield management. Together, Airfield Management and Base Civil Engineering, along with

any additional off-base assistance, must work in concert to develop short and long-term solutions to their bird hazard problems.

A long list of active controls exists, but only the more important ones are discussed:

- Pyrotechnics
- Bioacoustics
- Depredation
- Acetylene or carbide gas cannons
- Falconry

Because these aspects of bird control have been written about rather thoroughly, see the Handbook on Bird Management and Control, published by the BASH Team and Frightening Devices For Airfield Bird Control by Defusco for additional information. These two publications will also explain many of the other techniques which have not been as successful as the methods mentioned above or which have not yet been fully evaluated.

Pyrotechnics.

Pyrotechnics are some of the most effective bird control devices available. In spite of the diversity of pyrotechnic materials presently on the market (Defusco and Nagy, 1983:35), airfield managers will want some of the more common items in their possession. With pyrotechnics an explosive charge is fired 50-100 meters into the air and detonated to create a loud noise and a flash of bright

light. The most commonly used item is the scare cartridge or shell-cracker which is fired from an open-choke 12-gauge shotgun or an M-8 Very pistol with a steel sleeve insert (BASH, 1983:5). Another common device uses a M-74 airburst (Very flare) fired from an M-1 flare pistol (Lucid and Slack, 1980:84). A third type of pyrotechnic, a bird bomb, uses a special pistol with a small powder cartridge. Ranges for these items are: 30-40 yards (27-37 meters) for the Bird Bomb, 27-55 yards (25-50 meters) for the M-74 airburst, and 100-110 yards (90-100 meters) for the Scare Cartridge.

When used properly, pyrotechnics provide the user with a versatile, all-weather capability, which can effectively repel such common birds as blackbirds, crows, gulls, starlings, and waterfowl (Lucid and Slack, 1980:84). Other species which respond well include shorebirds, cattle egrets, and cedar waxwings. Pyrotechnics are less effective for such birds as pigeons or House Sparrows. Hawks are more difficult to disperse (Reznick, 1984:279), but shell crackers used at close range may be effective, as was found in an Asian study with raptors (Defusco and Nagy, 1983:36). Trapping birds that are not repelled by pyrotechnics, and transporting them to another location, may be the solution (see Part II. CE).

When used by themselves, pyrotechnics will disperse

birds, but in time the birds will become accustomed (habituate) to the noise. Pyrotechnics work best when combined with other repulsion techniques, such as recorded distress or alarm calls. Success with all these techniques is not only achieved through operator's perseverance but also through a mixed use of the methods available. Moreover, the time intervals between the use of pyrotechnics and other repulsion methods must be changed periodically to prevent birds from habituating to the scare tactics of the operator. Thus, it is important to apply a diversity of methods on an irregular schedule (Lucid and Slack, 1980:85).

When applied properly pyrotechniques will greatly aid the airfield manager. A few examples are given here. When trying to disperse birds such as gulls from their roosting area near the runway, use shellcrackers during the evening as the gulls approach their roost (Defusco and Nagy, 1983:35). Birds scare more easily in the air than when settled down. If the birds are established in their roosting area, disturb them on a daily basis over a period of several days. Persistence is the key, and in some cases it may be necessary to use live ammunition. If birds are shot, let the dead birds remain in an area where they are visible to the incoming birds. After the birds have dispersed, the dead birds should be removed so as not to attract scavengers. Dead birds can be left on the

ground for several hours, but should be picked up before the evening.

Pyrotechnics can offer the user a certain degree of directional control (BASH, 1983:5). When a scare cartridge is fired between a flock of birds and the runway, the birds will normally fly away from the disturbance. If the shots are fired systematically on alternating sides of the flock, the skilled user can "herd" the birds off in the desired direction. If the birds begin to associate the same vehicle with the shots, they may eventually disperse automatically when they see that vehicle.

As might be expected there are some safety precautions that must be considered when using pyrotechnics:

- Most importantly, pyrotechnics could cause a fire hazard in an area of dry vegetation.
- Finding a safe and secure area to store the pyrotechnics may create a problem. Problems may arise with the storage of these devices, and also with unexploded cartridges (Defusco and Nagy, 1983:37)
- Used shells may create a foreign object damage (FOD) problem
- Always coordinate the use of pyrotechnics with the control tower

- Do not scare birds into the flight path of arriving or departing aircraft (BASH, 1983:5)
- Coordination with security police is always advisable

According to the BASH Guidance Package there are four basic safety guidelines to follow when using pyrotechnics (BASH, 1983:5):

- Never fire toward aircraft, buildings, or people
- Wear ear and eye protectors and gloves
- Train personnel properly before pyrotechnics are used
- Have a Safety Operating Instruction to govern pyrotechnic use and storage IAW AFR 127-100

For assistance with this last item, consult the Base Security Police. Be aware that permits may be required in certain cases.

Although there are many products on the market, the Air Force authorizes the pyrotechnic devices listed in Table 1. These devices can be procured from the respective Table of Allowances (TA). (See Table I for the item descriptions and corresponding national stock numbers, part numbers, and TA references)

As an alternative to shellcrackers and flares, an airfield manager might select rope firecrackers, which, as the name implies, are powerful firecrackers connected by their fuse to a cotton rope (Defusco and Nagy, 1983:36).

The spacing of the firecrackers along the rope determines the explosion intervals. The rope, which is suspended, burns slowly above the ground where the noise will carry further. These devices disperse the same species mentioned earlier in this section, but must be moved every two to three days to prevent bird habituation. Although functional in fog or drizzle, they would be difficult to use in the rain (Lucid and Slack, 1980:87). Because of the fire hazard involved, a non-combustible catch-all/container should be placed under the suspended rope. Like before, permits may be required to handle these firecrackers. Preassembled products can be purchased from commercial suppliers, as can the individual items.

Bioacoustics.

The bioacoustic method is one of the most effective bird dispersal techniques, particularly if it is applied correctly. By means of loud-speakers mounted on a vehicle and a cassette player with amplifier, tapes of actual bird distress or alarm calls are played to scare away flocks of birds, such as gulls, blackbirds, and starlings. Although the initial investment is fairly high, the results should make the investment cost-effective (Defusco and Nagy, 1983:29).

If available, alarm calls are recommended over distress calls because birds generally react more quickly

to them (Lucid and Slack, 1980:81). There is a definite distinction between the two types of calls and also between the responses of birds in the vicinity. Birds give distress calls after being exposed to danger (Defusco and Nagy, 1983:26). Alarm calls are emitted when a potential threat is detected. While distress calls will initially attract birds to the source of the sound before dispersing them, alarm calls will normally disperse birds directly. Moreover, distress calls are more species-specific, whereas several species can react to a single alarm call.

Since the airfield can be noisy at times, the sound system must be able to play the tapes loudly and clearly (Lucid and Slack, 1980:81). The system must be capable of 30-50 watts of power with distortion-free sound to produce 90-110 db with a frequency response ranging between 12,000-14,000 Hz. When the birds are identified, the operator must drive to within 100-200 meters of the birds and STOP the vehicle (BASH, 1983:6). The appropriate tape is played for 15-20 seconds and stopped to allow the birds to respond. Allow 15-30 seconds. The cycle is repeated a second or third time, but if no response occurs the tape should be considered ineffective. If several different tapes are played and this technique fails to disperse the birds, other methods will have to be tried.

As mentioned above, the playback of taped calls has

been highly successful in dispersing flocks of gulls from airfields, and likewise effective with blackbird and starling roosts (Lucid and slack, 1980:79). This technique is most effective before birds become established in the area, and least effective with nesting species. Through careful observation transient birds can be identified and easily moved on their way.

Because some species will react only to their own calls, care must be taken to correctly identify the bird species. Try several different tapes. Experiment but do keep a log of what works, where it works, and under what conditions. Realize that taped calls also have limitations. Some species, such as pigeons and house sparrows, will not respond to distress calls (Lucid and Slack, 1980:79). Raptor calls, in some cases, may be effective on other species but not on their own kind. Realize that sound carries better downwind than upwind. Most important, operators must not over-use bird recordings, because bird habituation can result (Lucid and Slack, 1980:81). Continuous playback is never recommended!

In spite of the initial expense, bioacoustics are practical and safe. However, two safety precautions must be considered. As effective as they are, taped calls may cause the birds, such as gulls, to circle overhead and create a temporary flight safety hazard until they fly

elsewhere (Lucid and Slack, 1980:82). As mentioned in the previous section, bioacoustics are frequently used in conjunction with pyrotechnics, with which the operator must be thoroughly familiar. Naturally, if live ammunition is fired, extreme care and coordination must be exercised.

Authorized bioacoustic equipment is covered in Table of Allowances 483. (See Table I for the item description, NSN, part number, and TA reference) Recorded tapes can be obtained through the BASH Team. Several commercial sources can also provide many of the required items.

Depredation,

From time to time it is necessary to shoot and kill a few birds to reinforce other dispersal techniques, such as airbursts, gas cannons, or recorded distress calls. It also provides the emphasis that "danger" is at hand. Starlings, English Sparrows, and domestic pigeons can be killed outright, but to kill most other species (including gulls and blackbirds), which are federally protected, requires a Federal depredation permit (BASH, 1983:7). Available from the U.S. Fish and Wildlife Service, the permit stipulates the numbers of each species which can be killed. Depredation also includes the use of approved poisons, which are discussed separately in Part II.

Although live ammunition can be used to scare birds, it is mostly used sparingly to kill birds. This technique

may be most effective on those birds which are normally hunted (Defusco and Nagy, 1983:31), such as waterfowl and game birds, particularly during the migratory periods.

Oddly enough, when this technique is applied as a control method for gulls, it is generally ineffective.

The best results are obtained when birds are shot in the air and not on the ground (Defusco and Nagy, 1983:31).

-- DO NOT shoot into the center of the flock of birds, because they will disperse in all directions
(Godin, 1984)

Those that are killed should be placed in a spot where they are visible to the rest of the flock. However, the dead birds should be removed when the control measures are completed, so as not to attract scavengers. To be more effective, the same vehicle should be driven each time the "shotgun patrol" is called out. Birds will soon recognize the vehicle and will disperse quickly. To be more effective, it is recommended that the operator(s) get out of the car or truck before attempting to shoot.

Needless to say, shooting live ammunition is hazardous to people, aircraft, and buildings. Consequently, only skilled marksmen should handle this equipment. The Security Police Squadron should be able to name several people who could help when the need arises. Any other people attempting to use live rounds should have the proper training before shooting birds in the

runway/flightline environment. Contact Security Police for assistance in handling weapons with live ammunition. For authorized shotguns, see Table I.

Acetylene or Carbide Gas Cannons.

Known collectively as automatic exploders, gas cannons produce a loud sound of exploding gases at regular intervals. The noise is similar to that of a 12-gauge shotgun, and is effective over about 10 acres. The interval between blasts is controlled by the gas pressure in the storage tanks (Defusco and Nagy, 1983:33).

Although mixed reports exist about the effectiveness of automatic exploders, it is claimed that they are more effective on species that are normally hunted, such as waterfowl and pheasants. Suggested for use in open spaces, gas cannons will have varying degrees of success with gulls, blackbirds, starlings, crows, and other birds (Lucid and Slack, 1980:86). It has been reported that gulls, which are not hunted, quickly adapt to the harmless cannon explosions (Defusco and Nagy, 1983:33).

Because habituation can easily occur, cannons should be operated along with other control techniques, such as live ammunition or airbursts. Effectiveness is improved if the exploders are pointed downwind. Also, the positions of the cannons should be changed periodically, once or twice a day (Defusco and Nagy, 1983:34). To counter the habituation results of most models, some

models use two cannons, mounted in opposite directions. The setup will rotate freely in the wind or after each blast. Thus, the direction of the sound changes randomly. If a model of this type is employed, it is recommended that two consecutive blasts be fired: one to disturb the flock and one to disperse it.

Although the gas cannons produce no harmful effects on birds, they do create a loud noise which carries several miles, particularly over water. Local residents may complain if the method is used frequently. Although not overly dangerous, the flammable gas is a safety hazard. As with live ammunition and other pyrotechnic devices, a permit may be required. For authorized gas cannons see Table I.

Falconry.

Although not actively used to any great extent in this country, falconry has been employed successfully in other countries as means of a bird control. A unique feature of falconry is that birds never get used to the presence of falcons (a raptor), and because of this fact, the method should not be entirely overlooked (Defusco and Nagy, 1983:43). However, because it requires highly skilled, dedicated, and licensed personnel, falconry is not normally recommended for Air Force use (Lucid and Slack, 1980:91). Further, falconry is generally ineffective during the night and during poor weather.

(Solman, 1984). The practice also requires much time, additional costs, and naturally an adequate number of trained birds. Bases desiring to start a falconry program for bird control should first contact the BASH Team and local falconry organizations experienced in handling birds of prey.

D. General Awareness and Education

For many bases bird/aircraft strike concerns are minimal. For other bases a higher degree of risk exists. In either case airfield managers should treat BASH problems as an "unexpected emergency" about to occur. The unique nature of bird hazards demands that managers be dedicated, motivated individuals, who stay well-informed on the current methods to prevent those hazards. Exchange of relevant information on a regular basis with other airfield managers, with members of the base BHWG, and with local wildlife experts means the creation of a well organized bird control program.

Many airfield managers will have to become self-starters in this area of concern and will have to develop techniques of their own for field observation. A basic knowledge of bird behavior will make a bird control program more manageable. Furthermore, excellent assistance can be obtained through the BASH Team, U.S. Fish and Wildlife Service, local authorities, and other organizations around the country. The problem will never

be totally eliminated, but it can be minimized through proper preparation and education of airfield management personnel.

To help managers become familiar with the basics of the BASH problem, several audio-visual productions are available through the base audio-visual service:

-- #38595-DF Bird/Aircraft Strike Hazards -

Close Encounters of the Worst Kind. 16mm, motion picture, color, optical, 14min 35sec, cleared for public release. Discusses frequency of bird strikes on Air Force aircraft, impact on mission, and why birds are attracted to the vicinity of Air Force bases. Describes some precautionary measures that can reduce these hazards. (1978-unclassified)

-- #50534-DF Bird/Aircraft Strike Hazard

Orientation. 35mm and 1/8in slide/tape, color, magnetic, cassette, 14min 30sec, not cleared for public use. Describes some of the potential hazards to aircraft from bird strikes. Explains some precautionary measures that can reduce these hazards.

-- An excellent 24 minute color film, Stop Bird

Strikes, produced by Transport Canada is available for loan or sale through a Chicago distributor. The film deals with airport management, staff training and motivating methods, some general features of bird

strikes, and some control techniques.

National Film Board of Canada

111 East Wacker Drive, Suite 313

Chicago, Illinois 60601 tele:(312) 565-0200

DAILY AIRPORT INSPECTION REPORT



Port of Portland

PORLAND INTERNATIONAL AIRPORT
DAILY AIRPORT INSPECTION REPORT

Date

198

Time

Inspector

RUNWAYS AND TAXIWAYS

	10R/ 28L	10L/ 28R	2/ 20	Taxi- ways	Remarks	Action Taken
Surface						
Edges						
Lights						
Paint						
Drainage						
Safety Area						

FIELD

	Remarks	Action Taken
Ramp Area		
Grass		
Perimeter Fence		
Lights (beacon, obst.)		
Birds		
Wind Socks		
Construction Areas		

ADDITIONAL COMMENTS:

Fig. 1. Port of Portland: Daily Airport Inspection Report



Port of Portland

OPERATION DEPARTMENT DAILY REPORT

OPERATION DEPARTMENT DAILY REPORT

Date _____

Runway/Taxiway

Inspections _____

Closures _____

Notams

No.

Description

Aircraft

Emergencies _____

Escorts/Assists _____

Searches _____

Landings Reports _____

Gate Assignments to Tower _____

Bird/Animal Control

Bird Strikes _____

Birds Trapped _____

Dead or Removed _____

Animals on Field _____

Security

Perimeter Checks _____

Airport Familiarization _____

Vehicle Escort _____

Assists

Comments/Special Projects

Fig. 2 Port of Portland: Operation Department Daily Report

PORLAND INTERNATIONAL AIRPORT

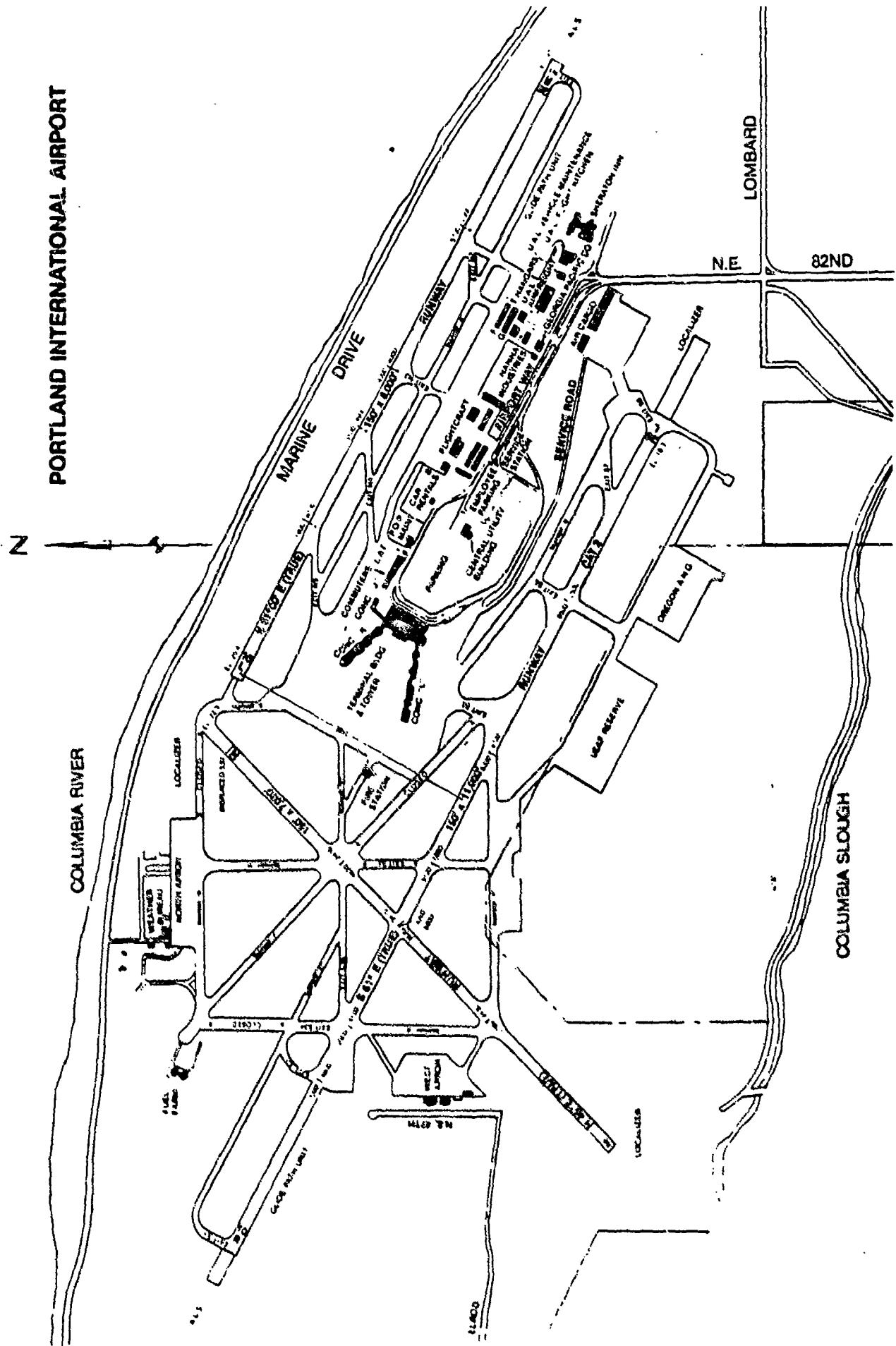


Fig. 3. Portland International Airport

TABLE I¹
Bird Dispersal Equipment

Item Description	NSN	Part Number	TA
Binoculars, prism type	6650-00-108-6629	PN6702513	015
Shotgun, single barrel, 12-gauge	1005-01-073-2368	PN Model 162	538
Shotgun, pump, 12-gauge	1005-00-973-5645	PN Model 870	538
Pistol, pyrotechnic (Very)	1095-00-726-5657	PN 7265657	538
Scare Cartridges, 12-gauge	1305-ND042951G	-	-
Cassette Tape Recorder	5835-01-053-3152	PN Model RS 248S	629
Speaker, High Power	5965-01-053-6210	PN Model AP30	629
Gas Exploding Cannon	3740-00-076-3541	-	483

¹Extracted from Bird Aircraft Strike Hazard (BASH) Guidance Package, 1983, pp. 4-5.

Bibliography

Bird Aircraft Strike Hazard Team (BASH Team). Bird Aircraft Strike Hazard (BASH) Guidance Package. HQ Air Force Engineering and Services Center, Tyndall AFB, 1983.

Defusco, Russell P. and Julius G. Nagy. Frightening Devices For Airfield Bird Control. Contract 29-2500. U.S. Fish and Wildlife Service, Denver Wildlife Research Center, Denver CO, March 1983.

Godin, Alfred. "Shotgun Patrol at Airports." Speech. Wildlife Hazards to Aircraft -Conference and Training Workshop. Charleston SC, 21 May 1984.

Kull, Captain Robert C. Jr. "1983 Air Force Bird Strikes," Proceedings: Wildlife Hazards to Aircraft - Conference and Training Workshop. 49-57. National Technical Information Service, Springfield VA, 1984.

Lucid, Vincent J. and Roy S. Slack. Handbook on Bird Management and Control. Contract F08635-77-C-0377. HQ Air Force Engineering and Services Center, Tyndall AFB FL, March 1980.

Long, Major Geral L., Chief, Bird/Aircraft Strike Hazard (BASH) Team. Personal interview. Tyndall AFB FL, 16 January 1984.

Reznick, Kaye. "Development of Bird Hazard Reduction For Airport Operational Safety," Proceedings: Wildlife Hazards to Aircraft - Conference and Training Workshop. 275-282. National Technical Information Service, Springfield VA, 1984.

Solman, Victor E. F. "Birds and Aviation," Proceedings: Wildlife Hazards to Aircraft - Conference and Training Workshop. 1-5. National Technical Information Service, Springfield VA, 1984.

Solman, Victor E. F. Telephone interview. Thurlow and Associates, Environmental Control Consultants, Ottawa, Ontario, Canada, 9 August 1984.

Part V. SAFETY

Because their main concern is flight safety, the Wing or Unit Safety Office will want to be most familiar with the hazards of bird/aircraft strikes, the methods to prevent or reduce bird strikes, and the procedures for reporting them. Foremost, the Safety Office will want to insure that a Bird Aircraft Strike Hazard Plan (BASH Plan) is established and that a Bird Hazard Working Group (BHWG) is formed to periodically review the potential bird threat and the means to prevent bird strikes. Each base will have its own bird problems, some of them predictable, some of them not. The key to a successful bird hazard prevention program lies in a well-organized, carefully designed BASH plan, which offers guidance to the appropriate base agencies should the need arise. Such a plan will be found in the appendix.

Although many incident, hazard, and bird strike reports are filed with the Safety Office, safety officers will have a better understanding and perspective of the bird strike problem if they read the Introduction to Chapters I and II and the Background/General Information sections of Chapters III and IV. The methods to prevent or reduce bird strikes are discussed throughout the remainder of the handbook. Even though procedures for reporting bird strikes are found in AFR 127-4 and AFR

127-15, it should be emphasized that all bird strikes must be reported to the Safety Office to insure a more complete BASH data base later on.

One of the most important ways the Safety Office can help is by conducting "bird strike avoidance training" at the squadron flying safety meetings. Any assistance that can be offered to the squadron flying safety officers in preparing for these meetings will develop a better awareness of the overall bird hazard. (Reference Section III, Operations, Part M)

For a sample list of safety office tasks and responsibilities, see the MacDill BASH Plan (B-1) in the appendix.

Part VI. AIR TRAFFIC CONTROL

Air Traffic Control (ATC), as represented by Control Tower personnel, play an integral part in bird/aircraft strike reduction. With their unique vantage point, they can provide much needed assistance to aircrews prior to and during (if necessary) two critical phases of flight: takeoff and landing. Although not their primary job, they may spot flocks of birds long before aircrews do, and advise them of any recommended action. Thus, just as aircrews must keep ATC informed, so too must ATC alert aircrews of any pending bird strike threat.

Air Traffic controllers need some knowledge about the overall bird/aircraft strike situation. For this reason, they should consult the General Information/Background section for Operations. Likewise, ATC should be represented on the BHWG, have a working knowledge of the Base BASH Plan (see appendix) and coordinate with other concerned agencies on base concerning matters of bird hazard control. To help establish a good data base for a given installation, controllers should keep daily records of both routine and unusual bird sightings. Routine sightings could be summarized periodically and easily coded. Where possible, controllers should attempt to identify bird species. (Reference Part IV. Airfield Management, section B)

There are several recommendations that will make for safer flying conditions. If bird activity seems high near the runway, it may be necessary to delay takeoffs or landings. If there are several aircraft in the traffic pattern or several aircraft arriving or departing, the "interval" might be decreased. Birds that have been initially frightened away will not return as quickly to the runway environment if the flying activity there is increased or maintained. During migratory periods, the airfield radar may detect flocks of birds, particularly when the visibility is poor or at night. It should be emphasized that migratory activity in the spring and fall occurs mostly during the night. Lastly, controllers must issue BIRD WATCH advisories to aircrews as required and update ATIS as often as possible to reflect current bird activity (BASH Plan, 1982:B-4). Sample BIRD WATCH conditions are listed in the MacDill BASH Plan included in the appendix.

Bibliography

Department of the Air Force. Bird Aircraft Strike Hazard Plan. 56 TTW Plan 127-15. MacDill AFB: 56th Tactical Training Wing, 30 September 1982.

Part VII. PROMISING NEW TECHNIQUES

Radar (NEXRAD)

One of the most promising new projects, to be operational in the near future, is the Next Generation Radar (NEXRAD). The new system, currently being designed to replace the present network of weather radars, will provide an integrated radar network throughout the continental United States at 200 kilometer (km) intervals (Larkin, 1984:369). The project, developed jointly by three U.S. government agencies (the Departments of Commerce, Transportation, and Defense) will have the ability to detect birds (Kull, 1983:7).

Using radar to detect and follow animal movements, including bird movements, is nothing new. However, when used for bird avoidance, NEXRAD will provide flexibility and "automated hazard warnings in real time" (Larkin, 1984:369). Bird hazard information will be displayed automatically. But, there is no guarantee it will be used to follow bird movements. As a unique feature NEXRAD will be able to detect a bird, such as a gull, out to a range of 450km. Thus, real-time bird movement information will be available to flight controllers and ultimately to aircrews.

Because NEXRAD is being designed as a weather radar, several problems will exist if it is to be used for bird

detection. First, the proper software will have to be developed, and assuming that weather identification will operate in parallel with bird identification, proper emphasis and funding will have to be given to the bird identification portion of the system (Larkin, 1984:371). Further, there are currently problems with a prototype version of NEXRAD to include resolution, ground clutter, and range complications. Lastly, a problem exists with low-level identification, which is the most critical zone for bird strikes. Because NEXRAD is currently going through its design stages and development, there is much optimism that it will benefit future bird avoidance measures.

Bird Avoidance Model (BAM)

The Bird Avoidance Model (BAM), as discussed in detail in part IV of this handbook, uses graphs which have been determined by the BASH Team to be 50-60% effective (by comparing BAM to actual bird strikes) in predicting bird strikes (Kull, 1983:7). By the late 1985, the data base will be enlarged with the addition of data on raptors. The revised model should be more effective but will still only depict graphic information for the period September to May (Kull, 1984). The data base has the potential of being enlarged even further, but the effectiveness of the new model and the users' response to it will determine how the model will be updated.

Bibliography

Kull, Captain Robert C. "Something New For Bird Strikes," Flying Safety, 39: 6-8 (June 1983).

Kull, Captain Robert C. Telephone interview. Bird Strike Hazard Team, HQ AFESC/DEVN, Tyndall AFB FL, 12 July 1984.

Larkin, Ronald P. "The Potential of the NEXRAD Radar System for Warning of Bird Hazards," Proceedings: Wildlife Hazards to Aircraft - Conference and Training Workshop. 369-379. National Technical Information Service, Springfield VA, 1984.

V. Findings

Because bird strikes create a significant problem today and because damage amounts to several million dollars each year, the authors of this thesis/handbook believe there should be more coordination among top level Air Force managers (MAJCOM and higher) to help improve the general awareness of the bird strike situation among commanders at all levels. Obviously the goal is to minimize the number of bird strikes, minimize the damage to aircraft, and to prevent injuries and fatalities.

As scarce resources became more valuable, the "wait until it happens" attitude will no longer suffice. Bird strikes are significant hazards within the Air Force, and commanders must recognize that fact. However, senior commanders must insure that base-level commanders are properly made aware, insuring that bases:

- Have an active Bird Hazard Working Group (BHWG)
- Have developed a base BASH Plan
- Are properly prepared to execute the BASH Plan

The emphasis should be on preparation in advance, not after the fact. The nature of the preparation will vary from base to base; and once the initial plan has been thoroughly developed, the most difficult part of any bird control activity will have been accomplished.

Not only must the Air Force improve coordination

among top level managers, it must also coordinate more with the U.S. Navy on many aspects of the bird threat, and to avoid possible duplication of efforts. While the Navy has civilian applied biologists working out of five Naval Facility Engineering Field Divisions (all part of Naval Facilities Engineering Command), the Air Force has one central location for the BASH Team at Tyndall AFB, Florida (Shultz, 1984:22). On occasion the BASH team has assisted the Navy, but because of limited staffing and funding limitations the team has not been able to support them on a routine basis.

The last statement suggests that the BASH Team is under-staffed. The team currently has three full-time Air Force biologists who spend much of their time on BASH-related temporary duty assignments. The current workload of the present staff of three leaves little time to do trip reports and analyses, follow-on studies, and special projects. Needless to say, little time exists to do much coordination among the commands and between the services. Totally ignored in the overall responsibilities of the BASH team is a necessary, small amount of research and development. The team at present is only responsible for projects, many of which are contracted out.

Thus, it appears that the BASH Team is only a consulting agency for the Air Force. No requirement exists for commanders to use their recommendations.

Because of the lack of awareness, understanding, and coordination among commanders concerning the bird strike matter, many BASH Team recommendations are not fully appreciated. Further, many commanders do not know what information is available to them. Ironically thousands of dollars are spent by the BASH team to gather the best and most current information available, for a problem that costs the Air Force millions of dollars yearly, and yet there is no formal requirement or emphasis to properly "educate the masses" with regard to the problem and the many techniques available to them.

Another important finding uncovered an easily overlooked aspect of the bird strike problem; damage caused by high speed strikes is overshadowed by the more prevalent bird strikes in the vicinity of the airfield (Speelman, 1984). In other words, because more bird strikes occur in the low speed environment of the airfield, more attention is devoted to the low speed bird strike. This aspect concerns mostly airfield and wildlife management. A solution is achieved by removing birds from the aircraft flight path as best possible. Compared to low speed strikes, high speed strikes involve a larger portion of the dollar damage caused by bird strikes. Many of these strikes are life-threatening and are generally associated with low-level runs. A solution in this case is accomplished by designing a canopy, windshield, or

transparency that can withstand high speed impact.

One responsibility of the Air Force Wright Aeronautical Laboratory is to design and test aircraft components, such as canopies or windshields, so that they can withstand high speed impact. But, this necessary structural designing only enhances one portion of the aircraft, namely the canopy or windshield. We believe that the total aircraft should be designed to withstand high speed impacts. The technology is available, but the cost is a short-term drawback: It costs too much to strengthen the whole aircraft. Yet, the reduction in bird strike repair costs should be considered against this initial cost of strengthening too. Also needing consideration is the time that an aircraft stays in not-mission-capable (NMC) status while parts are on order from the depot. Likewise, the cost of dispatching a depot repair team to a base to help repair an aircraft must be taken into account. The cost of sending the depot team, and their man-hours for repair, must be included in the cost of repair so that this cost is considered when deciding which alternative is more practical: Initial strengthening of aircraft or repair of non-strengthened aircraft when necessary. Another cost to be considered is the cost to readiness when an aircraft is awaiting parts or repair.

In conclusion, a general observation is that bird

strikes are too often overlooked as a serious problem. Air Staff and MAJCOM attention need to focus on this hazard. Recommendations made by the BASH team need to receive the widest dissemination. Individual bases need to be held responsible for setting up a WORKING BASH plan.

Bibliography

Schultz, Harvey A. "Don't Fowl Out," Proceedings: Wildlife Hazards to Aircraft - Conference and Training Workshop. 13-23. National Technical Information Service, Springfield VA, 1984.

Speelman, Ralph. Personal interview. Air Force Wright Aeronautical Laboratory, Wright-Patterson AFB OH, 20 January 1984.

**HEADQUARTERS
56th TACTICAL TRAINING WING
MACDILL AFB, FLORIDA**



**56 TTW PLAN 127-15
BIRD AIRCRAFT STRIKE HAZARD PLAN
30 SEPTEMBER 1982**



DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 56TH TACTICAL TRAINING WING (TAC)
MACDILL AIR FORCE BASE FL 33608

REPLY TO
ATTN OF: SE

16 Feb 84

SUBJECT Change 1 to 56 TTW Plan 127-15, Bird Aircraft Strike Hazard Plan

TO: SEE DISTRIBUTION (Page Z-1)

1. This is Change 1 to 56 TTW Plan 127-15, 30 September 1982, and is effective upon receipt.

2. The following pen-and-ink changes will be made:

a. Page B-5, Para 10a. Delete remainder of sentence following Birdwatch Condition and replace with "on CCTV".

b. Page R-1, para 2b(1). Line 2, change sighting surveys to R-2-2, R-3-2, and R-4-2. Delete R-2-1, R-3-1, R-4-1.

2. The following page change will be made:

REMOVE

INSERT

Z-1

Z-1

3. When posted, this letter will be filed immediately following the front cover.

Henry R. Kramer
HENRY R. KRAMER, Lt Col, USAF
Chief, Safety Division

1 Atch
Page Change



DEPARTMENT OF THE AIR FORCE

HEADQUARTERS 56TH TACTICAL TRAINING WING (TAC)
MACDILL AIR FORCE BASE, FL 33601

REPLY TO
ATTN OF SE

30 September 1982

SUBJECT 56 TTW Plan 127-15, Bird Aircraft Strike Hazard Plan

TO. SEE DISTRIBUTION (ANNEX Z)

1. This plan provides guidance for reducing the bird strike hazard in the areas where the 56 TTW conducts flying operations.
2. This plan is effective on receipt.
3. Tasked organizations will develop necessary checklists for implementation, and forward them to the Wing Safety Office for review.
4. This plan will be reviewed as of 15 September each year and updated as appropriate. Tasked organizations will review this plan 30 days prior to that date and forward comments to 56 TTW/SEF.
5. The Office of Primary Responsibility (OPR) for this plan is the 56 TTW Office of Safety, this Headquarters.

Viccellio
HENRY VICCELLIO, JR.
Colonel, USAF
Commander

HEADQUARTERS 56TH TACTICAL TRAINING WING
MACDILL AIR FORCE BASE, FLORIDA 33608
30 September 1982

56 TTW PLAN 127-15

SECURITY INSTRUCTIONS/RECORD OF CHANGES/ANNUAL REVIEW

1. The long title of this plan is 56 Tactical Training Wing Bird Aircraft Strike Hazard Plan 127-15. The short title is 56 TTW BASH Plan.
2. The overall classification of this document is UNCLASSIFIED.
3. Reproduction of this document in whole or in part is prohibited except as required for preparation of supporting directives, operating instructions or checklists.

RECORD OF CHANGES

CHANGE NUMBER	DATE	DATE POSTED	POSTED BY

RECORD OF ANNUAL REVIEW

REVIEWED BY	DATE REVIEWED	REMARKS

HEADQUARTERS 56TH TACTICAL TRAINING WING
MACDILL AIR FORCE BASE, FLORIDA 33608
30 September 1982

56 TTW PLAN 127-15
PLAN SUMMARY

1. PURPOSE: To provide a base program designed to minimize aircraft exposure to potentially hazardous bird strikes where the 56 TTW conducts flying operations.
2. CONDITIONS FOR EXECUTION: This plan is based on hazards from both indigenous bird populations and seasonal bird migration. Implementation of specific portions of the Plan are continuous, while other portions require implementation as dictated by bird activity.
3. OPERATIONS TO BE CONDUCTED:
 - a. Specific operations include:
 - (1) The establishment of a Bird Hazard Working Group.
 - (2) Procedures for reporting hazardous bird activity and altering/discontinuing flying operations.
 - (3) Provisions to provide information to all assigned aircrews and transient aircrews on specific bird hazards and procedures for avoidance.
 - (4) Actions to eliminate/reduce environmental factors which attract birds to the airfield.
 - b. Organizations tasked: As listed in ANNEX A.
 - c. Supporting plans are required.

HEADQUARTERS 56TH TACTICAL TRAINING WING
MACDILL AIR FORCE BASE, FLORIDA 33608
30 September 1982

56 TTW PLAN 127-15
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HEADQUARTERS 56TH TACTICAL TRAINING WING
MACDILL AIR FORCE BASE, FLORIDA 33608
30 September 1982

56 TTW PLAN 127-15 - BIRD AIRCRAFT STRIKE HAZARD PLAN
BASIC PLAN

REFERENCES: AFR 127-15
BASH Survey
Other (Reports, letters and supportive material provided by competent biologists or wildlife managers.)

TASKED ORGANIZATIONS: ANNEX A

1. SITUATION:

a. GENERAL. This Plan establishes an overall bird control program for MacDill Air Force Base and is designed to minimize aircraft exposure to potentially hazardous bird strikes or strikes with terrestrial animals. The hazards to safe flying operations posed by birds are so varied that no single solution to the bird strike problem exists. This Plan is designed to:

(1) Establish a Bird Aircraft Strike Hazard Working Group.

(2) Establish procedures to identify and to communicate high hazard situations to aircrews and supervisors to determine if altering/discontinuing flying operations is required.

(3) Determine aircraft and airfield operating procedures to avoid high hazard situations.

(4) Provide for dissemination of information to all assigned aircrews and transient aircrews on specific bird hazards and procedures for avoidance.

(5) Decrease the attractiveness of the airfield to birds by eliminating, controlling or reducing environmental factors which support the birds, to include bird harrassment as necessary.

b. AIRFIELD/LOCAL AREA. MacDill AFB occupies 5,620 acres in Hillsborough County, Florida, and is located on a natural peninsula between Old and New Tampa Bays. The mean elevation of the base is 13 feet above Mean Sea Level (MSL). MacDill AFB is drained into several natural creeks, drainage ditches and by tidal action. There are approximately 890 acres of undeveloped land on MacDill AFB most of which is on the south side of the base complex. The underdeveloped land mainly consists of Red, Black, and White Mangrove with a small proportion being planted Pine with varied understory, mature Pine with mixed understory of Pine, Grass, Pine Brush, Scrub Oak and Palmetto. The southwestern portion of the base is being invaded by Florida Pepper and mixed brush. The area adjacent to the runway consists of a mix of Florida grasses which is closely maintained. The infield area which is only periodically maintained is being invaded by Dog Fennel, Ragweed, Sesbania and some brush, consisting of Wax Myrtle, Florida Pepper, Willow, and Scrub Oak. In addition, there is a 13 acre borrow pit which has been turned into a pond located just north of the field boundary adjacent to the runway and a dump 8,500 feet southeast of the runway. The Mangroves, wooded areas, pond and grasslands surrounding the airfield and the landfill provide a large variety of habitats capable of supporting birds hazardous to aircraft. In particular, the pond is attracting waterfowl; the landfill, seagulls, and the invasion by uplands vegetation is attracting upland species which have become permanent residents of the area. More specific hazards are listed in ANNEX C.

c. EN ROUTE/LOW-LEVEL FLYING AREAS. Aircraft flying out of MacDill generally use southern Florida as the primary route and low-level flying area. This area has many features which attract a variety of birds from migratory waterfowl through upland species, to shore birds. The two most hazardous species being the raptors (vultures) and the migratory waterfowl. Specific en route hazards are outlined in ANNEX C.

d. AVON PARK GUNNERY RANGE. Avon Park occupies 107,000 acres of land in Polk and Highlands counties in central Florida and most of the area is typically Southern Florida flatwoods comprised of nearly level sandy flatlands interspersed with small swamps and wet grasslands. Other parts of the area are fragmental remains of a relatively high sand ridge consisting of droughty sands interspersed with small, poorly drained areas and few ponds. The

flatwoods represent approximately 57,000 acres of the area. Of this, 27,000 acres have been reforested with slash pine, starting in 1965. Plantations were established in various sized blocks and are distributed throughout the area. Approximately 4,000 acres of this type are stocked with natural stands of slash pine of 30-50 years of age. The remaining area is essentially unstocked, with saw palmetto, gallberry, and native grasses comprising the majority of the cover. Approximately 20,000 acres of small swamps and wet grasslands are interspersed throughout the flatwoods type. These areas vary considerably in size and vegetation, from open ponds with marsh grasses; dense hardwood swamps with various species of gums, bays, ash and maple; pond and bald cypress stands of varying ages; and two extensive marshes, one of approximately 3,200 acres located along the southwest boundary of the installation, the other approximately 2,800 acres located along the southeast boundary. The sand ridge area comprises 9,400 acres, oriented north-south in the center of the installation. This type is made up of sand pine of 10-40 years of age in dense stands, open scrub oak associations with scattered long leaf pine, and long leaf pine stands, 40-60 years old. The terrain in and around Avon Park provides an abundant variety of habitats for birds that are hazardous to aircraft. Specifics are outlined in ANNEX C.

2. EXECUTION:

a. CONCEPT OF OPERATIONS.

(1) Overall OPR and monitor for the implementation of this Plan is the 56 TTW Office of Safety.

(2) Bird Aircraft Strike Hazard Working Group.

(a) Function. Review data on bird strikes, identify and initiate actions to reduce hazards, review and implement changes in operational procedures, prepare informational programs for aircrews.

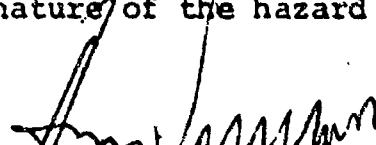
(b) Authority. The BASH Working Group submits all efforts to the operational commander for approval. Implementation is through normal chain of command.

(c) Composition. The chairman, as appointed by the Commander, will be the 56 TTW Vice Commander. As a minimum, the group will consist of a representative from

the Deputy for Operations, Standardization/Evaluation, Flight Safety, Airfield Management, Civil Engineering and representatives from other Tasked Organizations (ANNEX A) as required.

(d) Meeting Schedule. As required. When requested by any member of the Working Group.

b. TASKS. ANNEX B outlines the general and continuing tasks and responsibilities for each organization. ANNEX C lists specific tasks to counter hazards that are discovered and will remain in effect only until the hazard is removed or reduced sufficiently as determined by the seasonal nature of the hazard or by the BASH Working Group.


HENRY VICCELLIO, JR.
Colonel, USAF
Commander

ANNEXES:

- A - Tasked Organizations
- B - Tasks and Responsibilities
- C - Operations
- Q - Maps and Charts
- R - Reports and Forms
- S - Bird Hazard Warning System: Operation Birdwatch
- Z - Distribution

HEADQUARTERS 56TH TACTICAL TRAINING WING
MACDILL AIR FORCE BASE, FLORIDA 33608
30 September 1982

ANNEX A TO 56 TTW PLAN 127-15
TASKED ORGANIZATIONS

<u>ORGANIZATIONS</u>	<u>COMMANDER</u>
56 TTW/CC	Commander
56 TTW/DO	Deputy Commander
56 TTW/MA	Deputy Commander
56 TTW/SE	Chief
56 TTW/PA	Chief
56 CSG/DE	Chief
56 CSG/OTM	Chief
1928 CG	Commander
1928 CG/FFC	Chief
56 CSS/OT	Range Operations Officer
Det 32, 3 WS	Commander
61 TFTS	Commander
62 TFTS	Commander
63 TFTS	Commander
72 TFTS	Commander

HEADQUARTERS 56TH TACTICAL TRAINING WING
MACDILL AIR FORCE BASE, FLORIDA 33608
30 September 1982

ANNEX B TO 56 TTW PLAN 127-15
TASKS AND RESPONSIBILITIES

1. SAFETY:

- a. Include BASH group recommendations and actions and report on strikes and hazards in the agenda and minutes of the Wing Quarterly Safety Council.
- b. Establish procedures for reporting and recording all birdstrikes at MacDill or involving 56 TTW aircraft.
- c. Monitor activities of all tasked agencies for compliance with this directive.
- d. Disseminate BASH data to BASH group and flying units.
- e. Provide the BASH Working Group with the current BASH reduction data received from Higher Headquarters, the U.S. Fish and Wildlife Service and other agencies.
- f. Maintain a current bird activity map for MacDill, Avon Park, and the low level routes.
- g. Provide, in addition to the above, as much information concerning bird migratory activities as can be obtained through contact with the U.S. Fish and Wildlife Service and local bird study groups.
- h. Monitor hazard levels and advise the chairman of the Working Group when a meeting is deemed necessary.

2. PUBLIC AFFAIRS:

56 TTW Public Affairs will participate as required and upon request will provide a public information program designed to inform base personnel, dependents and the general public on the hazards of uncontrolled bird activity and the measures being taken to minimize them.

3. BASE AUDIO VISUAL SERVICES:

a. Provide photographic services as required to document bird strikes and related activities as required.

b. Provide graphics as required to publicize the hazards and actions required to minimize them.

4. BASE CIVIL ENGINEER:

a. Provide an environmental officer to the BASH Working Group to monitor and advise the group on Environmental Modification. The Base Civil Engineer is responsible for developing procedures for removal or control of as many bird attractants as possible and initiating the necessary surveys and writing of environmental impact assessments and statements on procedures undertaken as required by law.

b. In addition to providing those services as required to eliminate specific habitats to counter identified hazards, the Civil Engineer will develop a long-range program in conjunction with all base improvements and modifications, in an attempt to make the airfield as unattractive to birds as feasible. This project/program should be termed operation "Bird Bare." Forward a copy of this program to 56 TTW/SE.

c. To assist in this program the following general Civil Engineering considerations are suggested for inclusion in the program:

(1) Control vegetation.

(a) Mowing Operations - (specify frequency and desired height)

(b) Ditches - proper slope and clear

(c) Filling low spots

(d) Planting bare areas

(e) Removing dead vegetation/rubble (perches)

(f) Remove high spots (perches)

(g) Remove edge effect

(h) Remove plants with berries

- (2) Control water.
 - (a) Modify ditches - slope and clear
 - (b) Consider covering culverts
 - (c) Eliminate standing water
 - (d) Patrol/clear beaches and rip edge of feeding materials
 - (e) Drain marsh areas
- (3) Control waste
 - (a) Collect appropriately
 - (b) Dispose of rapidly
- (4) Control birds (Chemical/Physical Alterations)
 - (a) Check/bird proof buildings - hangars
 - (b) Check other perches/towers, etc.
 - (c) Use avitrol as required
 - (d) Use naphthlene around perches (Alt)
 - (e) Sticky material around perches (Alt)
 - (f) Electrical charge around perches (Alt)
 - (g) Strobes
 - (h) Queletox (Kill)
 - (i) Control insects

5. FLYING ORGANIZATIONS:

a. Will insure aircrews participate in the BASH reduction program by promptly reporting all bird strikes and hazardous conditions IAW this directive.

b. Squadron Flying Safety Officers (FSOs) will periodically obtain the current bird activity data and post the information so that it is readily available for briefing aircrews.

c. Squadron FSOs will insure that the current bird activity data is available and briefed in conjunction with the prephase briefing for both the ground attack and low-level phases.

d. Squadron FSOs will insure an adequate supply of BASH Report Forms and Bird Activity Maps are readily available for the airmen.

6. STANDARDIZATION/EVALUATION:

a. Review with 56 TTW/DO all proposed new low-level routes or changes to existing low-level routes for BASH impact.

b. Monitor, on a regular basis, airmen preflight briefings to insure BASH is covered during the briefing.

7. AVON PARK OPERATIONS:

a. Utilize the Bird Hazard Warning System (ANNEX S) to report significant bird activity noted on the gunnery ranges to the Wing SOF (2288) and SEF (2480) and advise airmen under their control of same. (Refer to Range OI 65-5.)

8. AIR TRAFFIC CONTROL OPERATIONS:

a. Report observed bird activity to the SOF during normal 56 TTW flight operations and to Airfield Management at other times.

b. Issue Birdwatch advisories to aircraft as required.

c. Provide Airfield Management immediate access to the runway under Birdwatch Condition Red if required.

9. AIRFIELD MANAGEMENT:

a. IAW ANNEX S of this Plan, during normal 56 TTW flight operations, the authority to declare a Birdwatch condition is vested with the SOF. The MacDill AFB Chief of Airfield Management or his designated representative, is the declaring authority during all other periods.

(1) Declaration of a Birdwatch condition by the Chief of Airfield Management should be based upon the following:

(a) Information relayed by airborne aircraft.

(b) Observations made by and relayed to Base Operations by MacDill AFB Tower and Transient Alert personnel.

(c) Observations made by Base Operations personnel.

(2) Birdwatch conditions may be downgraded or canceled by the agency declaring the condition, commensurate with updated information.

b. The Chief of Airfield Management or his designated representatives, will be a prime source for observing conditions that could create a bird strike hazard and will react to disperse flocks of birds found on taxiways, runways, North and South ramps, and the pier at the approach end of runway 04. Sighting surveys will be filled out and sent to 56 TTW/SE as appropriate.

(1) Environmental conditions observed in the runway vicinity that could attract birds will be reported to the Environmental Section, 56 CSG/DE (i.e., standing water areas/areas of recently mowed grass/confirmed and suspected roosting areas.)

(2) Carry out those actions as required for implementation of Birdwatch procedures as outlined in ANNEX S.

10. DET 32, 3RD WEATHER SQUADRON:

a. Display Birdwatch Condition notice (S-1-1) on TV briefing equipment on CCTV.

b. Advise aircrews of Birdwatch Conditions when briefing weather.

11. DEPUTY COMMANDER FOR OPERATIONS:

a. Provide a capability for declaring, disseminating and terminating Birdwatch conditions on MacDill or low-level routes and at Avon Park (ANNEX S).

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16 Feb 87

b. Issue specific guidance for aircrew and the SOF on procedures to be followed under Birdwatch Conditions (ANNEX S-5).

c. Issue specific guidance to the Command Post concerning actions required to implement this Plan (ANNEX S-4).

12. DEPUTY COMMANDER FOR MAINTENANCE:

a. Issue specific guidance to AGS personnel for the reporting of discovered bird strikes on aircraft to Quality Control and Safety.

b. Issue procedures for the preservation of bird remains (feathers only) during non-duty hours if discovered on an aircraft.


HENRY VICCELLIO, JR.
Colonel, USAF
Commander

HEADQUARTERS 56TH TACTICAL TRAINING WING
MACDILL AIR FORCE BASE, FLORIDA 33608
30 September 1982

ANNEX C TO 56 TTW PLAN 127-15
OPERATIONS

REFERENCES: (Bird/Aircraft Strike Hazard Team Reports from other wildlife agencies, etc.)

1. GENERAL.

a. PURPOSE. The ANNEX provides information on the different types of bird strike hazards and recommendations on countering each hazard.

b. MISSION. See Basic Plan.

2. CONCEPT OF OPERATIONS. The following is a summary of the bird strike hazards and recommendations for reducing each hazard to flight operations. A brief description of each bird and how each method of control or avoidance is to be employed is provided. Each control measure will have a corresponding tasked organization in the Basic Plan.

3. SPECIFIC HAZARDS.

a. MACDILL AFB AREA.

(1) Brown Pelican (*Pelecanus Occidentalis*).

(a) Hazard: This protected species can be seen frequently on the catwalks of the approach lighting for runway 04. It also flies in small flocks (3-6 birds) in varied formations. Pelicans feed primarily on small fish and dive from altitudes of 30 feet or less. The primary threat occurs when the small flocks transit the runway approaches and departures in search of food.

(b) Hazard Reduction: Habitat modification is not feasible nor desirable for this species. The primary counter to this hazard is increased awareness by aircrews and runway supervisory personnel. The approaches should be closely monitored for their activity and appropriate advisories should be transmitted as required.
OPR: 56 TTW/DO/OTM.

(2) Seagulls (Charadriformes, Laridae).

(a) Hazard: This species provides the largest threat to flight operations in the airfield area. Several subfamilies are permanent residents of the bay area as well as a migratory hazard. Seagulls are primarily scavengers and gather at garbage dumps, docks and other lucrative sources of food. Their travels from roost to food source to loafing areas constitute the greatest hazards.

(b) Hazard Reduction: Habitat modification and control techniques must be devised to effectively reduce the threat.

1. The source of easy food and fresh drinking water near loafing areas within the general airfield area must be reduced to an absolute minimum. The sanitary landfill operation must be closely monitored as it is the major attractant and food source. Every consideration must be given to controlling insect and vegetation both through the use of chemicals and a vigorous mowing program. OPR: 56 CSG/DE

2. Once the food source is eliminated, action will be taken daily to reduce the attraction of the loafing areas such as clear ramp space and closely mowed fields through the use of harassment and dispersal procedures such as pyrotechnics or bioacoustics as appropriate. These same techniques will be vigorously employed during Bird Conditions Yellow and Red. OPR: 56 TTW/OTM

(Other resident species in the immediate area which are being studied as needed include:

Raptors, owls, nighthawks, doves, cattle egrets, common crows, cormorants, shorebirds, plovers, pipers, upland species, blackbirds, starlings.

In addition to the migratory species: Waterfowl, Ibis, Cranes.)

b. AVON PARK RANGE.

(1) Turkey Vultures (*Cathartes aura*) and Black Vultures (*Coragyps atratus*).

(a) Hazard: These species appear to be randomly distributed throughout the range. There are no specific roosting areas known for these birds, nor has

any correlation been noted between sightings and ground vegetation. Maximum flight altitude during the cool season appears to be 1,000 ft AGL. This altitude increases during the hot summer months when the vultures use thermals to aid soaring flights.

(b) Hazard Reduction: The range should be periodically surveyed for vulture roosting sites. Once these sites are located, they should be removed or relocated. Aircrews must increase lookout during all operations below 1,000 ft AGL, paying particular attention to operations from the 10,000 ft VTRP to the nuclear target. Aircrews must alert other flight members and the RCO or Avon operation of all sightings. OPR: 56 CSS (Avon Park) and 56 TTW/DO.

(2) Herring Gulls (*Larus argentatus*):

(a) Hazard: These birds are found primarily in the vicinity of Lake Arbuckle. They are scavengers by nature and are attracted to this area because of an open landfill on state property between Lake Arbuckle and Frost Proof road.

(b) Hazard reduction: Habitat modification and control techniques must be used to effectively reduce the hazard presented by these birds.

1. Proper maintenance of airfield grass areas will also reduce the food source and a loafing area.

2. Other methods available are harassment and dispersal procedures. OPR: 56 CSS (Avon Park).

(3) Other common bird species in the Avon Park complex observed are: Cattle Egrets (*Bubulcus ibis*), Purple Martins (*Progne subis*), and Eastern Meadowlarks (*Sturnella magna*).

(a) These species were observed primarily in the grassy areas of the airfield in small numbers. They presently do not constitute a BASH problem.

(b) Proper maintenance of the grass areas will reduce this hazard. OPR: 56 CSS (Avon Park).


HENRY R. KRAMER, Lt Col, USAF
Chief, Safety Division

HEADQUARTERS 56TH TACTICAL TRAINING WING
MACDILL AIR FORCE BASE, FLORIDA 33602
30 September 1982

ANNEX Q TO 56 TTW PLAN 127-15
MAPS AND CHARTS

1. GENERAL: This ANNEX outlines the use and requirements for the maps and charts required to implement the BASH Program to include:

- a. MacDill AFB Habitat Map.
- b. Low-level Bird Activity Map.
- c. Avon Park Bird Activity Map.
- d. Airfield Bird Activity Map.

2. MACDILL AFB HABITAT MAP:

a. Background: A habitat survey was conducted at MacDill AFB in August 1978 and the specific habitats which are available to birds were determined. The description of the habitats and modifiers are in APPENDIX 1 of this ANNEX. A copy of the survey is maintained at the Environment Office (DEEV).

b. Use: Once a specified hazard is identified and the location of the activity can be isolated, the habitat map should be consulted to determine if a specific attractant to that species exists which can be altered within the scope of this program.

c. The habitat map will also be used as a guide for the long-range Civil Engineering Program of removal of actual and potential habitats on MacDill AFB, proposed Operation "Bird Bare."

3. LOW-LEVEL ACTIVITY MAP: (R-4-1)

a. A map with a depiction of all the common low-level routes will be maintained at the Office of Safety (SEF).

b. All bird strikes which are reported on the low-level routes will be plotted on this map.

c. This data will be studied and disseminated to the flying units IAW the procedures outlined in ANNEX B.

d. This data will also be used to determine if certain route usage be discontinued or altered.

4. AVON PARK ACTIVITY MAP: (R-3-1)

a. A map of the Avon Park Gunnery complex will be maintained at the Office of Safety (SEF).

b. This map will be used in the same manner as the Low-Level Map.

5. AIRFIELD ACTIVITY MAP: (R-2-1)

a. A current map of MacDill airfield will be maintained at the Office of Safety (SEF).

b. This map will be used in the same manner as the Low-Level Map.



HENRY R. KRAMER, Lt Col, USAF
Chief, Safety Division

Appendix 1
1 - MacDill AFB Habitats

HEADQUARTERS 56TH TACTICAL TRAINING WING
MACDILL AIR FORCE BASE, FLORIDA 33608
30 September 1982

APPENDIX I TO ANNEX Q TO 56 TTW PLAN 127-15
MACDILL AFB HABITATS

Water:

Modifier - Varies from fresh to salt, strength depending upon site.

- Burrow ponds; drainage ditches; natural ponds tidal creeks, open bay.

Mangrove: Red, Black and White

Modifier - Mangrove along drainage ditches and on higher sites invaded by Florida Pepper bushes.

Hardwood Hammock: Oak

Grass:

Modifier - Closely maintained in and around runway and primary roads.

- Periodically maintained in fields, irrigation site, etc. May be invaded by Dog Fennel, Ragweed, Sesbania and some brush.
- Disturbed sites where grass is primary invader, but being replaced by brush.

Wet Grass:

Modifier - Areas, either natural or manmade, where moist soil, plants, red root, Sagittaria, Beakrush, Cyperus, etc., dominate.

Borrichia, Glasswort Flats:

Modifier - Type is largely being lost in invasion by Florida Pepper.

- Type also contains Salt bush (Baccharis) invaders.

Brush: Wax Myrtle, Florida Pepper, Willow and Scrub Oaks

Modifier - Bush areas closest to salt water environments are predominantly Florida Pepper which has invaded and masked native species.

- Upland sites are Wax Myrtle and Saltbush. They contain a variety of species as transition area to high uplands.
- Upland brush contains Saw Palmetto, Scrub Oaks, Wax Myrtle, etc.
- Disturbed areas contain a mixture of broad leaf (Dog Fennel and Ragweed) and brush (Wax Myrtle, Florida Pepper, etc).

Planted Pines:

Modifier - Understory varies depending upon original site.

Mature Pines:

Modifier - Pine hardwood where pine is mixed with Scrub Oak and Palmetto.

- Pine/grass where grasses are mixed with broadleaf Plants and appear to vary from closely to occasionally maintained.
- Pine/brush where pine overstory is reduced with heavy brush understory varying with site from Florida Pepper to Palmetto, Cabbage Palm, Vitis and Wax Myrtle.



HENRY R. KRAMER, Lt Col, USAF
Chief, Safety Division

HEADQUARTERS 56TH TACTICAL TRAINING WING
MACDILL AIR FORCE BASE, FLORIDA 33608
30 September 1982

ANNEX R TO 56 TTW PLAN 127-15
REPORTS AND FORMS

1. GENERAL: This ANNEX outlines the procedures and forms required to report birdstrikes IAW AFR 127-15 and near misses to enhance the BASH Program at MacDill AFB.

2. AFR 127-15, BIRD STRIKE REPORT:

a. The Office of Safety will compile all reported bird strike data and submit the completed AF Form 441 to the BASH team at HQ AFESC/DEVN, Tyndall AFB, FL 32403 on 1 July and 1 January. Copies will be sent to 9th Air Force not later than the 15th of the month following the reporting period (semiannually). Information copies of this report will be furnished to the Wing Commander and the BASH Working Group.

b. The data will be collected through submission of the 56 TTW BASH Report Form.

(1) 56 TTW/SEF will insure sufficient copies of the BASH Report Form (R-1-1) and the sighting surveys (R-2-X, R-3-X, R-4-X) are available to all squadron FSOs and Base Operations.

*ch 1
16 Sept 82*

(2) The BASH Report Form will be filled out for all bird strikes or near miss situations. The activity maps will be completed by the aircrews after a sighting of large bird concentrations and by Base Ops following their daily airfield inspections.

3. PROCEDURES: All personnel discovering a bird strike will notify Wing Safety as soon as possible. This is required to insure that the evidence is preserved for identification of the bird species involved in the strike. The most important identification features that should be preserved are feathers. During non-duty hours, Maintenance and Base Operations personnel will make arrangements for the preservation of evidence until Wing Safety assumes responsibility for them.

a. The aircrew involved in the strike will fill out the BASH Report Form, providing as much information as possible concerning circumstances of the incident.

b. Base Operations personnel will assist transient crews in this and will obtain unit/organization information when damage occurs.

c. For MacDill AFB aircraft, if the damage is sufficient for AFR 127-4/127-18 Mishap Reporting, a Mishap Report will be submitted in addition to the BASH Report Form.



HENRY R. KRAMER, Lt Col, USAF
Chief, Safety Division

Appendices:

- 1 - BASH Report Form
- 2 - Airfield Bird Activity Map
- 3 - Avon Park Bird Activity Map
- 4 - Low-Level Bird Activity Map

HEADQUARTERS 56TH TACTICAL TRAINING WING
MACDILL AIR FORCE BASE, FLORIDA 33602
30 September 1982

APPENDIX 1 TO ANNEX R TO 56 TTW PLAN 127-15
BASH REPORT FORM

FROM: SQUADRON _____ AIRCREW _____

CALL SIGN _____ DATE _____

SUBJECT: Birdstrike Worksheet

TO: 56 TTW/SEF

This report is to be filled out for all actual birdstrikes or any near miss situations. Your help on close encounters will greatly help in getting action taken to reduce the hazards involved with birds in our local flying area. Fill in all blocks as well as you can. Give approximations if exact data is unknown and indicate that it is an approximation. If you have any questions, call 56 TTW/SEF, 2480.

a. Month/day of occurrence: _____

Local time: _____

b. Light conditions (circle or use other if significant): Dawn, Hazy, Bright, Dull, Dusk, Dark, Night, other: _____

c. Aircraft type: _____ Aircraft serial Nr: _____

d. Landing light (ON/OFF): _____

Beacon/strobe lights (ON/OFF): _____

e. Phase of flight (describe): _____

f. Aircraft speed: _____ Heading: _____ Altitude: _____ MSN:

g. Flight path (in relation to clouds if any, i.e., above, below, etc): _____

h. Geographic location: (try to be as specific as possible) _____

coordinates: _____ (if in pattern (flare, short final,etc) _____ any ground references: _____)

i. Species and number of birds (if unknown, try to describe, color, size, etc): _____

j. Impact point on aircraft (if applicable): _____

k. Evasive action:

(1) By pilot (YES/NO) _____ What? _____

(2) By bird (YES/NO) _____ What? _____

l. Bird remains on aircraft (YES/NO): _____

Scoop whatever feathers, flesh, etc, that are available into a plastic bag (obtainable from Maintenance) and notify Safety, ext 2480 ASAP. The remains will be collected by a representative from Safety for evaluation.

m. Pilot warned of activity prior to strike (YES/NO) _____

n. Low-level route number (if applicable) _____

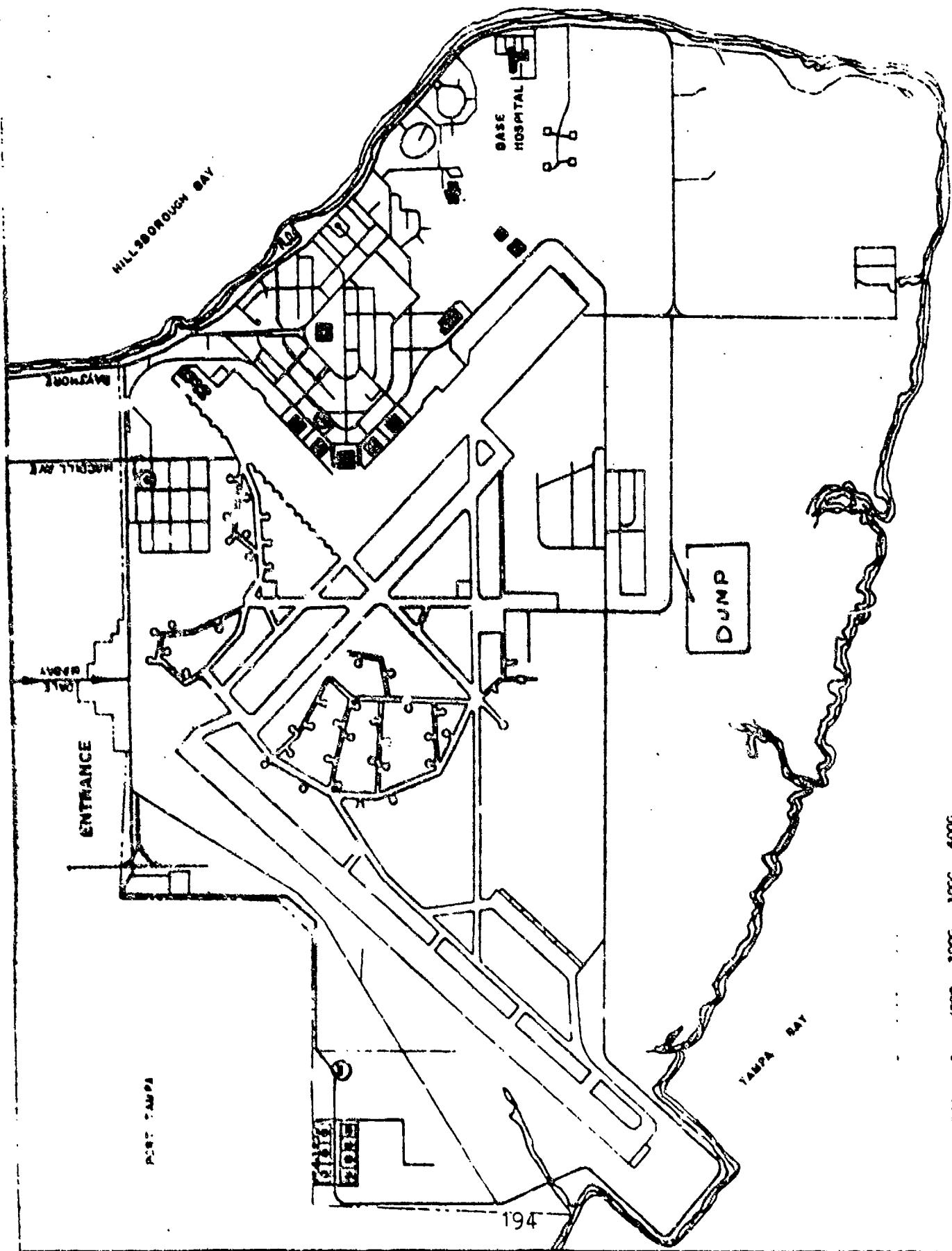
o. Remarks (any information you may feel valuable to the program, i.e., what were the birds doing when you saw them?)

p. Safety Mishap Report Number _____. (If applicable)

q. Estimated damage cost \$ _____. (If applicable)

HEADQUARTERS 56TH TACTICAL TRAINING WING
MACDILL AIR FORCE BASE, FLORIDA 33608
30 September 1982

APPENDIX 2 TO ANNEX R TO 56 TTW PLAN 127-15
T-3 FIELD BIRD ACTIVITY MAP



i. Species and number of birds (if unknown, try to describe, color, size, etc): _____

j. Impact point on aircraft (if applicable): _____

k. Evasive action:

(1) By pilot (YES/NO) _____ What? _____

(2) By bird (YES/NO) _____ What? _____

l. Bird remains on aircraft (YES/NO): _____
Scoop whatever feathers, flesh, etc, that are available into a plastic bag (obtainable from Maintenance) and notify Safety, ext 2480 ASAP. The remains will be collected by a representative from Safety for evaluation.

m. Pilot warned of activity prior to strike (YES/NO) _____

n. Low-level route number (if applicable) _____

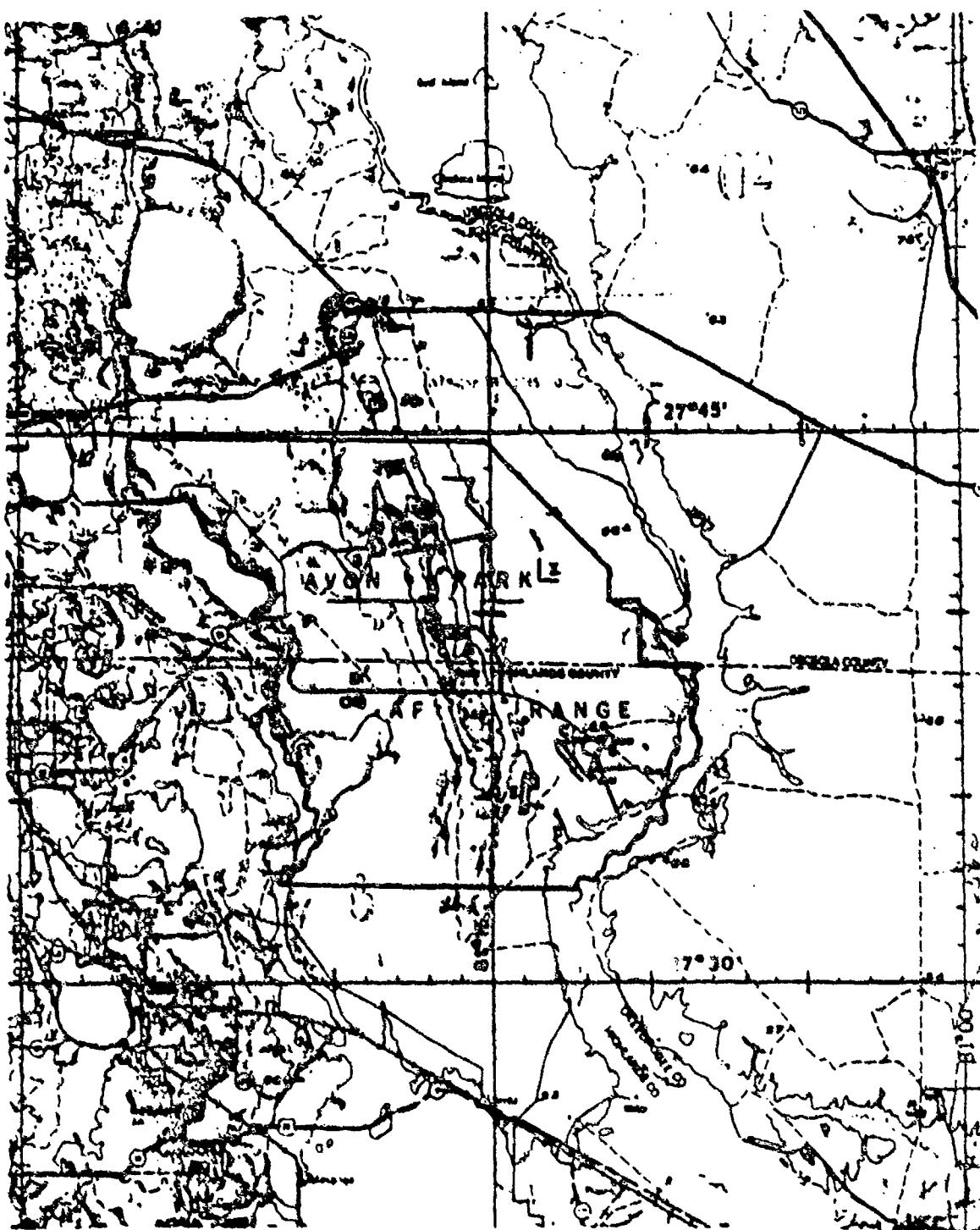
o. Remarks (any information you may feel valuable to the program, i.e., what were the birds doing when you saw them?)

p. Safety Mishap Report Number _____ . (If applicable)

q. Estimated damage cost \$ _____ . (If applicable)

HEADQUARTERS 56TH TACTICAL TRAINING WING
MACDILL AIR FORCE BASE, FLORIDA 33608
30 September 1982

APPENDIX 3 TO ANNEX R TO 56 TTW PLAN 127-15
AVON PARK BIRD ACTIVITY MAP



FROM: _____

BIRD SIGHTING REPORTTO: TTW/SEF

SIGHTING NUMBER	BIRD TYPE & QUANTITY	BIRD ACTIVITY	SCARE TACTICS	DATE & TIME
1				
2				
3				
4				
5				
6				

1. Fill out the log above on any sightings of birds in quantities greater than 10. Be sure to circle the sighting location on the map with the sighting number inside the circle.

2. Use the terms below to help in filling out this report.

COMMON BIRD TYPES:

1. Pelican
2. Seagull
3. Dove
4. Cattle Egret
5. Blackbird
6. Turkey Vulture
7. Hawk
8. Meadow Lark
9. Killdeer
10. Starling

COMMON ACTIVITIES:

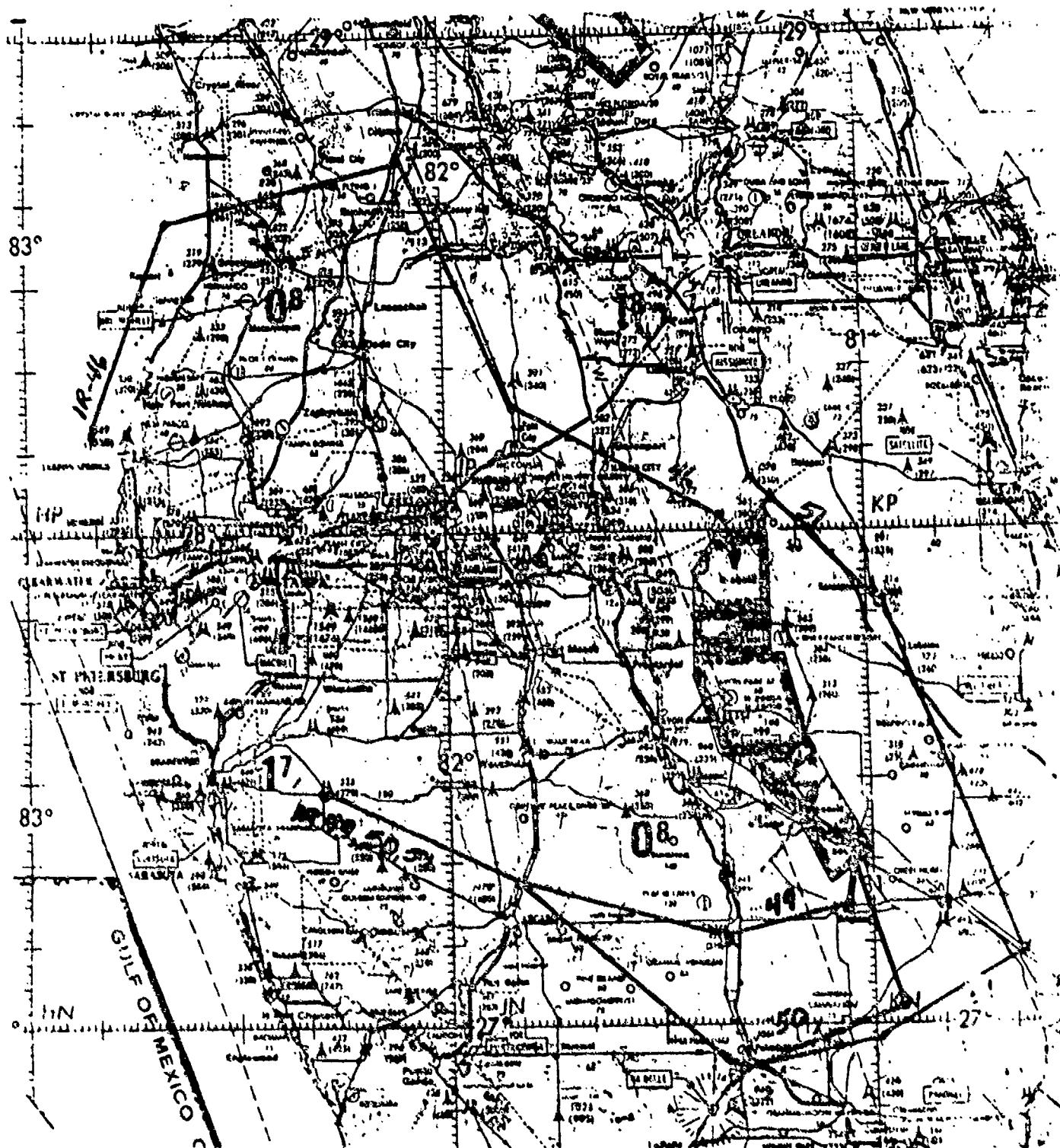
1. Flying: (specify approximate altitude on the log and indicate the general direction on the map with an arrow).
2. Soaring: (circling in one general area).
3. Loafing: (resting or sitting in one place).
4. Feeding.

3. Types of Scare Tactics:

a. Pyrotechniques.	d. None.
b. Harassment.	e. Other.
c. Distress calls.	

HEADQUARTERS 56TH TACTICAL TRAINING WING
MACDILL AIR FORCE BASE, FLORIDA 33608
30 September 1982

APPENDIX 4 TO ANNEX R TO 56 TTW PLAN 127-15
LAW LEVEL BIRD ACTIVITY MAP



FROM: _____

BIRD SIGHTING REPORTTO: TTW/SEF

SIGHTING NUMBER	BIRD TYPE & QUANTITY	BIRD ACTIVITY	SCARE TACTICS	DATE & TIME
1				
2				
3				
4				
5				
6				

1. Fill out the log above on any sightings of birds in quantities greater than 10. Be sure to circle the sighting location on the map with the sighting number inside the circle.
2. Use the terms below to help in filling out this report.

COMMON BIRD TYPES:

1. Pelican
2. Seagull
3. Dove
4. Cattle Egret
5. Blackbird
6. Turkey Vulture
7. Hawk
8. Meadow Lark
9. Killdeer
10. Starling

COMMON ACTIVITIES:

1. Flying: (specify approximate altitude on the log and indicate the general direction on the map with an arrow).
2. Soaring: (circling in one general area).
3. Loafing: (resting or sitting in one place).
4. Feeding.

3. Types of Scare Tactics:

- a. Pyrotechniques.
- b. Harassment.
- c. Distress calls.
- d. None.
- e. Other.

HEADQUARTERS 56TH TACTICAL TRAINING WING
MACDILL AIR FORCE BASE, FLORIDA 33608
30 September 1982

ANNEX S TO 56 TTW PLAN 127-15

BIRD HAZARD WARNING SYSTEM: OPERATION BIRDWATCH

1. GENERAL: This operation establishes procedures to be used for the immediate exchange of information between ground agencies and aircrues concerning the existence and location of birds which could pose a hazard to flight.
2. BIRD WATCH CONDITIONS: The following terminology will be used for rapid communications to disseminate bird activity and implement unit operational procedures.
 - a. Bird Watch Condition RED. Heavy concentrations of birds above and immediately in the vicinity of the runway or at a specific location on Avon Park/low-level route pose an immediate hazard to safe flying operations. The area declared RED shall be open only by specific pilot request upon being advised of the condition. (See 5b(1))
 - b. Bird Watch Condition YELLOW. Concentrations of birds observed or predictable in locations which represent a probable hazard to safe flying operations. Declaration of Condition YELLOW requires increased vigilance by all agencies and extreme caution by aircrues. (See 5b(2))
 - c. Bird Watch Condition GREEN. Normal bird activity in the area. Upon extended normal bird activity, no bird watch condition need be declared. (See 5b(3))
3. AUTHORITY: During normal 56 TTW flight operations the authority to declare a Bird Watch Condition is vested with the SOF. (RCO at Avon Park) The MacDill AFB Chief of Airfield Management or his designated representative (Avon Chief of Airfield Management for Avon Park) is the declaring authority during all other periods.

Bird Watch Condition YELLOW or RED will be declared for a special area upon the advice of tower, RSU Officers, RCO at Avon Park, GCA, or flight leads on low-level routes

OPR: 56 TTW/SE

when significant activity is observed visually or on radar. All operations personnel should be alert for bird activity and should report such directly to the SOF or Airfield Management (ext 2231) as applicable, or through one of the following agencies:

- a. Control Tower or GCA.
- b. Command Post.
- c. RSU.
- d. Avon Operations

4. COMMUNICATIONS. Bird Watch conditions will be disseminated by the following means:

a. During periods of 56 TTW flight operations the reported Bird Watch condition other than GREEN at MacDill AFB, Avon Park, and associated low-level routes will be included on the hourly ATIS information. When the SOF declares a Bird Watch condition YELLOW or RED, he will notify tower personnel and the 56 TTW Command Post. The Command Post will notify 56 TTW Safety (2480), Base Operations, and the four flying squadrons. Base Operations personnel will post the Bird Watch information in the Flight Planning Room for transient aircrew personnel and prepare Bird Watch condition display slides for the Det 32, 3 WS CCTV.

b. During periods of non-56 TTW flight operations: The Chief of Airfield Management or his designate will declare the Bird Watch condition. Upon declaration of a Bird Watch condition other than GREEN, Base Operations personnel will notify the 56 TTW Command Post and tower personnel. They will also insure Bird Watch information is posted in the Flight Planning Room.

c. The primary means of transmitting Bird Watch conditions will be via ATIS, and the weather monitor. However, under Bird Watch condition RED, the MacDill Air Traffic Control Agency will insure that the pilot understands the condition and is provided the option to delay, divert, or to continue the proposed operation into the hazardous area.

5. AIRCREW RESPONSIBILITIES AND PROCEDURES.

a. If while in flight, an aircrew observes or encounters any bird activity that would constitute a hazard to flight

the aircrrew should contact either the SOF, Control Tower, Flight Dispatch, Command Post, or Avon Operations and request that the observed bird activity be passed to the SOF (2288) or SEF (2480). The following information should be included:

- (1) Call sign.
- (2) Location.
- (3) Altitude.
- (4) Local time of sighting.
- (5) Approximate number of birds.
- (6) Type of bird (if known).

b. Additional direction to all pilots is provided below based upon the color coded BASH condition and the location identified.

(1) Condition RED:

(a) Traffic Pattern - Only full stop landings are permitted. The SOF will consider changing runways, delaying take-offs and landings, and diverting aircraft.

(b) Avon Park - A specific area and altitude will be identified. That area will be avoided by all flights using the range. (EXAMPLE: BRAVO POP-UP PATTERN DOWNWIND UP TO 1000 FT).

(c) Low-Levels - A specific route segment and altitude will be specified and will be avoided. (EXAMPLE: IR 46 C TO D BELOW 1000 FT).

(2) Condition YELLOW:

(a) Traffic Pattern - Patterns will be limited to the minimum required to fulfill training requirements. Pilots will be particularly cognizant of bird activity when on final and will go around immediately from low, flat approaches.

(b) Avon Park - Flight leads will change event order or amend altitudes (POP-UP DOWNWIND AND NUC PATTERNS) to minimize the hazard.

(c) Low-Level - Flight leads will amend altitudes to minimize the hazard.

(3) Condition GREEN:

All Locations - Used to downgrade from condition RED or YELLOW.

6. PROCEDURES FOR SOF AND DOC. If a bird activity report is received from an airborne aircraft, the Wing Safety Office or Base Operations will be notified as appropriate.

7. DOWNGRADING. Once a Bird Watch condition has been declared by the SOF or Base Operations personnel, it is their sole responsibility to either cancel or downgrade the condition commensurate with updated information.

8. BIRD WATCH ALERT. In addition to Bird Watch Conditions of RED, YELLOW and GREEN, a Bird Watch Alert may also be declared.

9. AIRFIELD MANAGEMENT PROCEDURES.

a. Base Operations will maintain and use pyrotechnic and bioacoustic devices during daily airfield inspections to keep birds from loafing in the vicinity of the airfield to include the taxiways, parking areas, and ramps. An individual will be designated to respond immediately to disperse birds when notified, also, usually by the SOF, of bird Condition YELLOW or RED. Extreme care must be exercised to insure birds are driven from the path of oncoming aircraft rather than toward them.

b. During normal airfield surveillance, airfield management will monitor loafing areas, grass height, etc., and report problems to local OPRs for modifying or eliminating the problem. The primary objective of airfield management's participation in this plan is to help eliminate the attractiveness of the taxiways, parking areas, and the runway environment as a loafing area.

10. DEPREDATION. The requirement for depredation will be determined jointly by SE and DEM. Once established, the Chief of Safety will determine the method (i.e., poison or shooting) and the agency to actually accomplish the kills.

DEM will insure proper permits are procured from local and federal Fish and Wildlife Services prior to engaging in depredation activities.



HENRY R. KRAMER, Lt Col., USAF
Chief, Safety Division

Appendix:
1 - Birdwatch Condition

HEADQUARTERS 56TH TACTICAL TRAINING WING
MACDILL AIR FORCE BASE, FLORIDA 33612
30 September 1982

APPENDIX I TO ANNEX S TO 56 TTW PLAN 127-15
BIRDWATCH CONDITION

BIRD WATCH

CONDITION

	MCF	IRs	RANGE	REMARKS
GREEN				
YELLOW				
RED				

HEADQUARTERS 56TH TACTICAL TRAINING WING
MACDILL AIR FORCE BASE, FLORIDA 33608
30 September 1982

ANNEX Z to 56 TTW PLAN 127-15
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SE	3
PA	1
61 TFTS	1
62 TFTS	1
63 TFTS	1
72 TFTS	1

56TH COMBAT SUPPORT GROUP

DE	3
OT	2
CSS	2

OTHER UNITS

Det 32, 3 WS	1
1928 Comm Gp	2

OPR: 56 TTW/SE

(Change 1, 16 February 1984)

VITA

Major Raymond P. Payson was born on November 1945 in Washington, D.C. He attended the University of Rhode Island from which he received the degree of Bachelor of Arts in Geology in January 1971. From November 1966 to May 1968 he attended the University of Heidelberg in Heidelberg, Germany, where he received the German equivalent of a Bachelor of Science in Geology. While doing some graduate study at Brown University in German from 1969 to 1971, he also completed a two-year Air Force ROTC program. After commissioning in 1971 he attended Undergraduate Navigator Training at Mather AFB CA, where he earned his wings on 1 February 1973. He then served as a KC-135 tanker navigator at Rickenbacker AFB, Ohio from 1973 to 1976 and as an instructor navigator at Plattsburgh AFB, NY from 1976 to 1983. From 1982 to 1983 he also served as Wing Tanker Navigation Officer, before entering the School of Systems and Logistics, Air Force Institute of Technology, in June 1983.

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Bristol, Rhode Island 02809

VITA

Captain James D. Vance was born on 6 July 1957 in Evanston, Illinois. He graduated from high school in Southborough, Massachusetts, in 1975 and attended the U.S. Air Force Academy from which he received the degree of Bachelor of Science in Political Science. Upon graduation, in May 1979, he received his commission. He attended the Aircraft Maintenance Officer Course (AMOC) at Chanute AFB, Illinois and was then sent to Myrtle Beach AFB, South Carolina. At Myrtle Beach he served as the Officer-in-Charge (OIC) for the 353rd Aircraft Maintenance Unit, until entering the School of Systems and Logistics, Air Force Institute of Technology, in May 1983.

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In recent years, much Air Force aircraft damage (about five million dollars per year) has resulted from bird strikes. Moreover, from 1968 to 1984, 13 military pilots were killed and 16 aircraft destroyed as a result of bird strikes. Instances of strikes are increasing, partly because better records are being kept and partly because aircraft are spending more time at the lower altitudes where strikes occur. As aircraft become more sophisticated and valuable, it is imperative that bird strikes be minimized to prevent aircraft damage or pilot injury.

To help develop more awareness about bird strikes and bird strike reduction techniques, this investigation compiled all relevant information through an extensive literature search, review of base-level documents, and personal interviews. The final product--A Bird Strike Handbook For Base-Level Managers--provides information on bird strike statistics, methods to reduce the strike hazards, and means to obtain additional assistance. The handbook is organized for use by six major base agencies: Maintenance, Civil Engineering, Operations, Air Field Management, Safety, and Air Traffic Control. An appendix follows at the end.

Because aircraft missions change from time to time, the nature of the bird strike problem also changes. More importantly, a bird problem can occur almost anywhere at any time. No base is free from the problem entirely. Through sound understanding of the hazards involved, through proper advanced preparation, and through daily monitoring of the bird threat, then and only then can the probability of a bird strike be minimized.